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QUARTERLY

OF THE

National Fire Protection Association

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EDITED BY THE SECRETARY

National Fire Protection Association.

Executive Office, 87 Milk Street, Boston, Mass.

Franklin H. Wentworth, Secretary

July, 1919

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American Institute of Consulting Engineers.
American Institute of Electrical Engineers.
American Ceramic Society.
American Electric Railway Association.
American Gas Association.
Arkansas Actuarial Bureau.
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Mutual Fire Prevention Bureau.
National Association of Building Owners and Managers.
National Association of Credit Men.
National Association of Electrical Contractors and Dealers.
National Association of Electrical Inspectors.
National Association of Insurance Agents.
National Association of Manufacturers of Approved Hollow Metal Window Frames and Sash.
National Association of Manufacturers of United States.
National Association of Master Gravel and Slag Roofers of America.
National Association of the Motion Picture Industry, Inc.
National Association of Sheet Metal Contractors of United States.
National Automatic Sprinkler Association.
National Board of Fire Underwriters.
National Convention of Insurance Commissioners.
National Electric Light Association.
National Implement and Vehicle Association.
National Lumber Manufacturers' Association.
National Paint, Oil and Varnish Association.
National Wholesale Druggists' Association.
National Wholesale Grocers' Association.
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New Brunswick Board of Fire Underwriters.
New England Bureau of United Inspection.
New England Insurance Exchange.
New Hampshire Board of Underwriters.
New Jersey Schedule Rating Office.
New York Board of Fire Underwriters.
New York Fire Insurance Exchange.
Newfoundland Board of Fire Underwriters.
North Carolina Fire Prevention Association.
Nova Scotia Board of Fire Underwriters.
Ohio Inspection Bureau.
Ohio State Fire Prevention Association.
Oklahoma Inspection Bureau.
Philadelphia Fire Underwriters' Association.
Philadelphia Suburban Underwriters' Association.
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Tennessee Inspection Bureau.
Texas Inspection Bureau.
Texas State Fire Insurance Commission.
The Union.
Underwriters' Association of the District of Columbia.
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Underwriters' Association of New York State.
Underwriters' Bureau of Middle and Southern States.
Underwriters' Bureau of New England.
Underwriters' Laboratories.
Underwriters' Service Association.
Vancouver Island Fire Underwriters' Association.
Water Works Manufacturers' Association.
Western Actuarial Bureau (Fire.)
Western Canada Fire Underwriters' Association.
Western Factory Insurance Association.
Western Insurance Bureau.
Western Sprinklered Risk Association.
West Virginia Inspection Bureau.
Wisconsin Inspection Bureau.

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Reports of fires appearing in the Quarterly are copies of or extracts from written reports forwarded to the Association. This Association, as a body, is not responsible for the statements or opinions of any of its members.

Courtesy Tennessee Fire Prevention Commissioner (Member N. F. P. A.)

HAZARDOUS CONDITIONS DISCOVERED IN MEMPHIS, TENN.

Similar conditions are permitted to exist in almost every city by citizens who are not deliberately selfish but only ignorant or careless. Such derelictions cannot be well handled by the ordinary machinery of the police department, and form the strongest argument for separate fire prevention bureaus or commissions.

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The Quarterly

Vol. 13 July, 1919 No. 1

The Twenty-Third Annual Meeting. The *Proceedings* of the Ottawa meeting, already in the hands of members, will convince those who could not attend this year that the Canadian adventure was a popular one. Everybody who could go seemed to have made the effort, and everybody who was there seemed to have something to say. There were no especially voluminous reports, and there was but one paper, that of Mr. Rudolph P. Miller on "The Certificate of Occupancy"; but the sessions ran the limit of time because of the discussions. A Canadian member attending for the first time asked the Secretary if there was any member present who did not speak. He declared he had never encountered such vitality in any organized body, and wanted to know where President Stewart was going for his vacation. He was not the only one to compliment the President on his dignified and effective conduct of the sessions. Everybody had his chance to speak, or, if he didn't, it wasn't the fault of the President, who exhibited neither impatience nor fatigue at any moment of the three busy days.

The Canadian members were admirable hosts, and the speaking at the opening session and at the two luncheons was very good indeed. Mayor Harold Fisher of Ottawa made a very favorable impression, which was cemented by his courtesies of Thursday when he was host at the luncheon tendered by the city.

The innovation provided by the Executives this year in the form of a Committee on Resolutions proved a useful one, a difference of opinion arising over the plank in the annual platform declaring for the abolition of the inflammable motion picture film. The Committee modified this, and the Association acquiesced.

A scattered opposition to the continuance of the Association's present policy of co-operation with the National Safety Council in promoting the observance of Fire and Accident Prevention Day disappeared by the time the report of the Committee on that subject was presented.

The definitions presented by the *Committee on Nomenclature* were once more attacked by the Association's experts in orismology, and the Committee is to be given another chance to find a satisfactory meaning

for the term "fire wall." The report of the *Committee on Field Practice* was this year again the subject of gunfire, and after a half-hour's attempted explanation and defense it was hurled at the head of the Executive Committee without recommendation. Because of the declaration of certain members that they didn't know the regulations governing *Signaling Systems* were being revised, the report of that Committee was referred back without discussion. The report of the *Committee on Inflammable Liquids* was also referred back for reconsideration and presentation next year, and the other two divisions of the old Explosives and Combustibles Committee—the Committees on *Gases* and *Hazardous Chemicals and Explosives*—both made successful adventure under their new Chairmen, Mr. Banash and Mr. Booth, which resulted in the adoption of revised regulations for *Gasolene Lighting Machines, Lamps and Systems,* and for the *Storage, Handling and Use of Nitro-Cellulose Motion Picture Film.* The Committee on *Pipe and Pipe Fittings,* under the direction of Mr. Teague, completed its work in the standardization of long and short turn fittings for sprinkler installations, and declared itself ready for a try at standards for pipe. The *Electrical Committee's* prospectus or revised layout of its work was officially endorsed and received favorable informal comment. The Committee on *Fire-resistive Construction* added to its fabric of standards, and received permission to ask the Executives to change its name to Committee on *Building Construction.* Items in reports of other committees were disposed of in ways satisfactory to the chairmen. On the whole, so far as the Association's technical work is concerned, it was a good meeting showing things definitely accomplished.

* * * * *

Fire at "Greene Park."

Members will recall that in April and July of last year the QUARTERLY contained editorial comment upon the extremely hazardous conditions obtaining at "Greene Park," an amusement area adjacent to Camp Lewis. Fortunately the fears then expressed were not realized during the period when a conflagration would have been attended with the greatest danger to life, but the story of the $150,000 fire which on May 23rd, 1919, destroyed the Hippodrome Theatre and the pool hall, and badly damaged a building known as the "China Inn," indicates how well-grounded those fears were. Within fifteen minutes after the camp fire detachments were summoned, the flimsily constructed theatre was a total loss. Very little imagination is required to picture what might have happened had this large building been crowded with people when the fire occurred. It is noteworthy that only the splendid work of the fire-fighters and favorable wind conditions saved a number of other buildings.

* * * * *

The Saskatchewan Fire Prevention Act.

Apropos of the article appearing in the April QUARTERLY under this caption, our attention has been drawn to Section 17, which provides as follows:

"Nothing shall render it obligatory for the Fire Commissioner, his deputy

or an inspector to perform in cities, towns or villages such of the duties prescribed by or under the authority of this Act relating to matters other than the investigation of fires."

It is easy to see how under the administration of an indifferent Commissioner the Act might practically become a dead letter so long as this section remained. While no doubt a vast amount of good can be accomplished under the law as it stands, it is obvious that its permanent value might be greatly increased by changing it from a permissive into a mandatory enactment.

* * * * *

Firemen Killed by Fumes of Pyroxylin Plastic.

A recent Detroit fire, in which two firemen lost their lives and many more were incapacitated, forcibly illustrates the importance of the problems of storage of pyroxylin plastic, with which the *Committee on Hazardous Chemicals and Explosives* is now grappling. It appears from the account given by City Fire Marshal Goldwater that the firemen were overcome when they entered the basement where the fire occurred among scrap pyroxylin plastic in 200-pound case lots. The scrap in this instance was required for making glue for use on the wings of air planes, but similar material is handled in considerable quantities in connnection with the manufacture of automobile tops and side curtains. With the object of safeguarding the lives of the firemen in future fires, Mr. Goldwater instituted an investigation of conditions in other establishments where pyroxylin plastic was present in quantities. Stocks ranging from a few hundred pounds to seven tons were found in various factories, the methods of storage and handling showing in many instances a surprising ignorance of, or indifference to, the hazards involved. The need for safety regulations along the lines of those already applied to film exchanges is clearly urgent in the case of factories handling pyroxylin plastic. A noteworthy fact is that the fire which caused the deaths of the two firemen was not a large one. It was extinguished by six sprinklers before it had gained enough headway to damage a frame partition six feet distant, and, apart from its demonstration of the deadly properties of pyroxylin plastic when ignited, it would have attracted no special attention.

* * * * *

Motion Picture Holocaust in Porto Rico.

Eighty corpses were removed from the ruins of the Yaguez Motion Picture Theatre, Mayagüez, Porto Rico, after a fire which destroyed the building in fifteen minutes on June 19, 1919. Serious injuries were sustained by many who escaped by jumping from windows or who were thrown down on the stairs in the mad rush from the building. It was the first show of the evening, and the audience consisted largely of children. The alarm was given when the show was nearing its conclusion, and almost immediately flames were visible to the audience. The number of fatalities was doubtless increased by panic, but the building was a wooden structure, and burned with frightful rapidity. Those in the balcony and gallery seats suffered most. While

the precise cause of the disaster has not been ascertained, it is believed that fire started at a circuit breaker or fuse located in the right side of the theatre near the stage, or among old films which were kept between the framework. It is probable that the conditions responsible for this holocaust were exceptionally bad, but there have been sufficient evidences of criminal carelessness in the handling and display of motion picture film in the smaller cities of the United States to destroy any feeling of security against a repetition of the Mayagüez horror nearer home. This holocaust carries with it a lesson which reckless handlers of film in schools, churches and club rooms would do well to take to heart.

* * * * *

Independence Day Hazard. Although no comprehensive figures are available as the QUARTERLY goes to press, there is evidence of the timeliness of the Association's appeal for a sensible observance of July 4th, 1919. In some places conditions recalled the days before the "safe and sane" movement became a power. The *Newark Evening News* commented severely upon the state of the public mind in that and surrounding cities, and also upon the apparent unwillingness of the Police Department to enforce the city ordinances regarding fireworks and explosives. One little girl was burned to death, five persons were slightly burned and the number of fire alarms was three times the normal. North Attleboro, Mass., was disgraced by a gang of youths who set five buildings afire and then hindered the work of the Fire Department. Seven stores were destroyed at Webberville, Mich., by a fire started when a skyrocket fell on the roof of a meat market. In many other cities the firemen had a busy day. When, however, the unusual difficulties of the occasion are taken into account, there is no reason for discouragement among the advocates of safety and sanity.

Meeting of Executive Committee.

The usual meeting of the executives following the annual meeting of the Association was held in New York City on June 19th for consideration of matters referred to the Committee by the Association, for revising the rosters of the various committees where necessary, and for consideration of reports, finances, communications, etc. The following members were present:

Rudolph P. Miller, New York, *Chairman.*
D. Knickerbacker Boyd, Philadelphia.
J. H. Brumbaugh, Chicago.
Gorham Dana, Boston.
J. H. Kenney, Baltimore.
R. H. Newbern, Philadelphia.
E. L. Sanders, Worcester.
C. L. Scofield, Montreal.
A. R. Small, Chicago.
F. J. T. Stewart, New York, *President.*
W. E. Mallalieu, New York, *Vice-President.*
Louis Wiederhold, Jr., Philadelphia, *Past-President.*
Franklin H. Wentworth, Boston, *Secretary-Treasurer.*

Messrs. Dana Pierce, Chairman Electrical Committee, and Ira H. Woolson, Chairman Committee on Building Construction, were present as invited guests.

In addition to the usual routine the following items of business were considered and action taken as indicated:

The *24th Annual Meeting* of the Association was set for May 4, 5, 6, 1920, in *Chicago,* and a *Program Committee* was appointed consisting of the President, Secretary, Chairman of the Executive Committee, and Messrs. W. S. Boyd and J. C. McDonnell of Chicago Chapter.

Messrs. D. Knickerbacker Boyd of Philadelphia and J. H. Brumbaugh of Chicago were appointed to complete the *Nominating Committee for 1920.*

The following organizations were elected members:

Association of the Fire Alarm Industry.
Fire Extinguisher Exchange.
Texas Inspection Bureau.

The *Budget* submitted by the Treasurer was *approved.*

The sub-committee, consisting of the Chairman, President and Secretary, appointed to consider ways and means for increasing the Association's revenue recommended a continuance of the special efforts now being made to increase the membership.

The proposed change in the *Year Book,* showing members both alphabetically and geographically, was *approved.*

The subject of more frequent meetings of the Executive Committee was discussed without action. It was informally agreed that it might be desirable for the various committees holding winter meetings to meet when convenient in New York during the week of the mid-winter meeting of the Executive Committee.

The sub-committee appointed to consider the question of the maintenance of the national character of the standards prepared by the Association was *continued.*

The resolution of G. E. Stecher (referred by the Annual Meeting) respecting buildings erected for temporary use during the war was *laid upon the table.*

The resolution of F. H. Cowles (referred by the Annual Meeting) respecting the appointment of a committee to investigate the merits of the *platoon system in fire departments* was considered. It was *voted* as the sense of the Committee that this matter was local to every city, and that it was inexpedient for the Association as a national body officially to consider it.

The resolution of George F. Lewis, adopted as amended by the annual meeting, memorializing the Federal, Dominion, State and Provincial Governments on the subject of the *Fire Waste,* was discussed on request of the Secretary as to desired action upon it. It was *voted* as the sense of the Committee that it is undesirable to attempt to promote such an effort by bulletins or written communications, and that special efforts to interest the governments should be deferred until sufficient funds may be available for presenting such matters in some more effective way.

The matter of the *Regulation of Explosives* was discussed and the correspondence of the Secretary with the Bureau of Mines was *approved.* It was *voted* as the sense of the Committee that Federal control of explosives, as exercised during the war, is desirable.

The policy of directing the Association's efforts toward securing the passage of enabling acts establishing administrative Fire Prevention bodies, with power to adopt and enforce fire prevention regulations in states, cities or metropolitan districts, rather than toward securing the adoption of the Association's technical regulations in the form of laws and ordinances, was *approved.*

The Secretary was requested to confer with the American Engineering Standards Association respecting the official adoption by that body of the National Electrical (Fire) Code.

It was *voted* to recommend to the Committee on Signaling Systems that in the further review of its report it should confer as fully and exhaustively as possible with the industries chiefly interested in the production and installation of signaling systems to the end that the

regulations may express and classify all present good practice in the fire alarm art.

It was recommended that the *Committee on Field Practice* prepare suggested installation rules for number and location of hand chemical extinguishers, confining its next report to these items.

The matter of *gate valve control* for *sprinkler systems,* referred to the Committee by the Annual Meeting, was *transferred* from the Committee on *Field Practice* to the Committee on *Automatic Sprinklers* for further investigation and report.

A rule was adopted that *voting by proxy* at meetings of special committees should not be permitted, but that any member of a committee may send a special substitute to express his views in the deliberations of the committee and deposit his vote.

The matters of limiting the size of committees and the rotation of their chairmen and members in office was discussed without action.

A campaign for promoting the observance of *"Clean-up Week"* was added to the jurisdiction of the Committee on Fire and Accident Prevention Day.

It was *voted* to request the Committee on Standardization of Pipe and Pipe Fittings to prepare standard regulations for iron and steel pipe, and in putting forward the work to get in touch with other organizations working on such standards.

The name of the Committee on "Fire-resistive Construction" was changed to "Building Construction."

The appointment of a Committee on *Aerial Fire Protection* was discussed *without action.*

The Committee on *Standpipe Systems* was *suspended* on recommendation of the Chairman thereof.

It was *voted* to create a Committee on *Docks, Piers* and *Wharves.* The members of this new Committee and changes, if any, in the membership of existing committees will be shown in the forthcoming *Year Book.*

Comparative Statistics of Fire Loss.

According to the latest report of the Committee on Statistics and Origin of Fires of the National Board of Fire Underwriters, the per capita fire loss of the United States during the year 1918 was $2.76, representing an increase of 34 cents upon the figure for 1917. Even without the Minnesota forest fires of last October, which are held responsible for a loss of $30,000,000, the total of the 1917 losses would have been exceeded. Although no doubt a considerable part of the excess may be accounted for by the great increase in values due to war-time prices, only a fallacious optimism will lay much stress upon this feature.

The Committee reports that the number of cities of twenty thousand population and over which fail to report their fires and fire losses is increasing. Cities reporting a loss of more than $5 per capita number 35, as against 29 in 1917 and 23 in 1916.

The following tables, taken from the Committee's report, give further details:

Cities in Which Loss Exceeded $5.00 Per Capita.

1918

Burlington, Vt.	$21.74	*Des Moines, Ia.	$7.14
Fort Smith, Ark.	19.79	Indianapolis, Ind.	7.06
Lima, Ohio	16.52	Pawtucket, R. I.	6.46
Kansas City, Mo.	12.86	Danbury, Conn.	6.45
*Oswego, N. Y.	12.76	Newark, N. J.	6.42
†Port Huron, Mich.	12.18	Findlay, Ohio	6.36
Canton, Ohio	11.33	*Jersey City, N. J.	6.19
‡Fresno, Cal.	10.72	*Wheeling, W. Va.	6.12
Hoboken, N. J.	10.47	San Antonio, Tex.	6.01
Revere, Mass.	8.76	*Little Rock, Ark.	6.00
Eau Claire, Wis.	8.68	Walla Walla, Wash.	5.91
*Duluth, Minn.	8.52	*Saginaw, Mich.	5.55
Leominster, Mass.	8.23	Chattanooga, Tenn.	5.44
*Memphis, Tenn.	7.93	Beaumont, Tex.	5.36
†Norfolk, Va.	7.72	Somerville, Mass.	5.26
Johnstown, Pa.	7.71	*Williamsport, Pa.	5.20
Bloomington, Ill.	7.34	Tulsa, Okla.	5.08
†Charlotte, N. C.	7.34		

1917

Hazelton, Pa.	$14.37	Omaha, Neb.	$6.81
Kansas City, Kan.	11.13	†Charlotte, N. C.	6.74
Lexington, Ky.	11.04	Springfield, O.	6.45
Lynchburg, Va.	10.42	†Dubuque, Ia.	6.31
*Albany, N. Y.	9.99	‡Fresno, Cal.	6.09
*Wheeling, W. Va.	9.58	*Augusta, Ga.	5.92
*Des Moines, Ia.	9.57	Nashua, N. H.	5.91
*Erie, Pa.	9.31	*Chicopee, Mass.	5.88
*Saginaw, Mich.	9.02	Council Bluffs, Ia.	5.85
Stamford, Conn.	7.95	El Paso, Tex.	5.57
†East St. Louis, Ill.	7.91	Paducah, Ky.	5.44
Hartford, Conn.	7.50	Boston, Mass.	5.27
Dallas, Tex.	7.30	*Houston, Tex.	5.14
Bangor, Me.	7.28	New Rochelle, N. Y.	5.01
†Norfolk, Va.	6.86		

1916

*Jersey City, N. J.	$27.71	*Houston, Texas	$6.90
Asheville, N. C.	14.93	†East St. Louis, Ill.	6.28
Ottumwa, Ia.	12.68	*Little Rock, Ark.	6.27
Green Bay, Wis.	12.08	*Chicopee, Mass.	5.97
†Dubuque, Ia.	9.12	Cedar Rapids, Ia.	5.94
Fall River, Mass.	9.09	*Portland, Me.	5.87
Shamokin, Pa.	9.07	Amsterdam, N. Y.	5.81
Peoria, Ill.	8.51	*Duluth, Minn.	5.75
†Norfolk, Va.	8.25	New Castle, Pa.	5.09
Columbia, S. C.	8.10	Spartanburg, S. C.	5.07
Sandusky, Ohio	7.60	Cohoes, N. Y.	5.05
Austin, Texas	7.43		

1915

Newport News, Va.	$28.00	Danville, Ill.	$6.86
Clinton, Ia.	12.46	Joliet, Ill.	6.83
*Augusta, Ga.	11.87	*Galveston, Tex.	6.52
Raleigh, N. C.	10.37	Springfield, Ill.	6.47
Key West, Fla.	9.41	‡Fresno, Cal.	6.24
Lockport, N. Y.	9.31	†Port Huron, Mich.	6.06
Muncie, Ind.	9.16	Salem, Mass.	5.85
Davenport, Ia.	8.80	Muskegon, Mich.	5.57
*Trenton, N. J.	8.11	*Williamsport, Pa.	5.48
*Erie, Pa.	7.78	†Dubuque, Ia.	5.35
*Shreveport, La.	7.64	Burlington, Ia.	5.14
Wilkinsburg, Pa.	7.50	*Oswego, N. Y.	5.14
*Montgomery, Ala.	6.94		

1914

*Galveston, Tex.	$33.06	Portland, Ore.	$6.78
Pottsville, Pa.	20.38	Kearny, N. J.	6.48
†Port Huron, Mich.	16.13	Kenosha, Wis.	6.47
*Trenton, N. J.	15.32	*Portland, Me.	6.26
Decatur, Ill.	15.28	Binghamton, N. Y.	6.24
Manchester, N. H.	14.07	Waco, Tex.	6.12
Superior, Wis.	13.86	†East St. Louis, Ill.	6.10
Charleston, W. Va.	13.83	*Shreveport, La.	6.05
Waterloo, Ia.	12.60	Pasadena, Cal.	5.97
Gloversville, N. Y.	12.29	Pittsfield, Mass.	5.93
‡Fresno, Cal.	12.03	Portsmouth, Ohio	5.93
*Montgomery, Ala.	10.51	*Memphis, Tenn.	5.67
Sioux City, Ia.	10.43	*Albany, N. Y.	5.46
Vicksburg, Miss.	9.38	Montclair, N. J.	5.12
Leavenworth, Kan.	9.12	Fort Worth, Tex.	5.05
Birmingham, Ala.	7.37	Mobile, Ala.	5.04
†Charlotte, N. C.	7.28		

*These cities in this class in two of the five years.
†In this class three of the five years.
‡In this class four of the five years.

*ANNUAL FIRE LOSSES IN THE UNITED STATES FOR FORTY-FOUR YEARS—1875-1918 INCLUSIVE.

YEAR.	AGGREGATE PROPERTY LOSS.	YEAR.	AGGREGATE PROPERTY LOSS.
1875	$ 78,102,285	1897	$116,354,575
1876	64,630,600	1898	130,593,905
1877	68,265,800	1899	153,597,830
1878	64,315,900	1900	160,929,805
1879	77,703,700	1901	165,817,810
1880	74,643,400	1902	161,078,040
1881	81,280,900	1903	145,302,155
1882	84,505,024	1904	229,198,050
1883	100,149,228	1905	165,221,650
1884	110,008,611	1906	518,611,800
1885	102,818,796	1907	215,084,709
1886	104,924,750	1908	217,885,850
1887	120,283,055	1909	188,705,150
1888	110,885,665	1910	214,003,300
1889	123,046,833	1911	217,004,575
1890	108,993,792	1912	206,438,900
1891	143,764,967	1913	203,763,550
1892	151,516,098	1914	221,439,350
1893	167,544,370	1915	172,033,200
1894	140,006,484	1916	214,530,995
1895	142,110,233	1917	250,753,640
1896	118,737,420	1918	290,959,885

*These figures are obtained from the Records of the Journal of Commerce, deducting the Canadian losses.

COMPARATIVE FIRE LOSSES.

	Population.	Total Loss.	Per Capita.
1914—Whole country	98,781,324	*221,439,350	2.24
298 cities	40,213,230	† 93,368,795	2.32
1915—Whole country	100,399,318	*172,033,200	1.71
333 cities	35,161,266	† 68,386,218	1.94
1916—Whole country	102,017,312	*214,530,995	2.10
329 cities	36,055,568	† 79,440,658	2.20
1917—Whole country	103,635,606	*250,753,640	2.42
327 cities	36,557,011	† 89,483,398	2.45
1918—Whole country	105,253,300	*290,959,885	2.76
328 cities	38,079,781	† 95,365,412	2.50

*Estimated. †Actual figures reported.

Miss Mamie McCann and the Portable Fire Escape.

or

The Wrong End of the Rope.

By A. T. Bell.
(Member N. F. P. A.)

On Saturday afternoon, August 17th, 1918, Miss Mamie McCann, occupant of room 119 at Cedarcroft, Atlantic City, N. J., and her room-mate, Miss Margaret Quinn, were discussing the possibilities of fire in that institution. The conversation led by easy steps to the portable fire escape hanging on the wall. Miss Quinn read the directions to Miss McCann. Miss McCann decided that she would "try it out." She accordingly put the belt carefully around herself and commenced a descent from the window of No. 119 to the roof of the laundry—one story below.

Her progress was soon interrupted by a kink in the rope. The window below being protected by a wire grill, one of the occupants of the building put a stick through it, on which Miss McCann rested her foot while Miss Quinn and two others pulled upon the rope until they released the kink and got everything clear. The journey was then satisfactorily completed.

Following this, and encouraged by her success in her first attempt, Miss McCann made a second trip without incident and quite satisfactorily. Immediately afterward Miss Quinn made a satisfactory trial trip without incident aside from the interest which was now being aroused in the occupants of the various rooms in Cedarcroft and Warwick and Chalfonte, which had an outlook on the scene of operations. Following this, Miss McCann made her third and fourth departures from the window sill in No. 119 and the corresponding arrivals on the laundry roof.

It then appearing to be time to venture something more, Miss McCann went to room 319—three flights from the laundry roof. A survey of the situation from this altitude, however, was discouraging, and so she came down a floor to No. 219. Miss Mary McDonald and Miss Catherine Flannigan were the occupants of this room. They were requested to afford the use of their fire escape for the descent. To this they rather reluctantly consented. Miss McCann uncoiled the rope on the floor. She then placed a belt around her body carefully. Then she sat on the window and waited for the auspicious moment to start.

At this juncture Miss Flannigan told her: *"You're in the wrong end of the rope."* Miss McCann's response to this was: *"I'll dare it."* With that she slipped herself off the window sill.

There being nothing to hold the loose part of the rope which was lying on the floor and to which the belt and Miss McCann were attached, she fell rapidly. Miss Flannigan, observing the rope going out with unusual speed, caught it and tried to stop it, but only succeeded in hurting her finger. In the fall Miss McCann pulled herself out of the belt, or perhaps she somersaulted herself out of it.

Miss McCann's right hip struck the laundry roof first. She rolled over and hurt her left arm. She either fainted soon after she slipped off the window sill or became unconscious when she landed. She has no recollection of what happened until she came to while being carried into Mrs. Hickman's office at Cedarcroft by the colored yardman and others who went to the roof of the laundry and brought her down. Later in the day she complained of feeling dizzy and vomited several times. Following this she felt better. Dr. Stewart, who examined her carefully within a half-hour after the "descent," said that there were no bones broken and no trouble except a severe shaking up.

On the following day, Sunday, August 18th, she was well enough to be about and receive callers. She would have resumed her duties as a waitress had she not been restrained. On Monday, the 19th, she went on duty, although still feeling very stiff.

The fire escape is still all right.

Moral:—Throw the coil out of the window *first*.

Loss of Life from Common Hazards, V.

Until the Bureau of the Census so subdivides its classification of the annual deaths from burning as to bring out in clear and unmistakable form the hazards of everyday carelessness, it will remain difficult for the fire preventionist to awaken the public conscience to the seriousness of the situation. The figures presented from time to time in this series of articles represent but a small fraction of the total number of deaths resulting from recklessness with matches, oil, and cigarettes, from failure to protect open stoves and similar derelictions.

The data now under review indicates that during the past few months child life has been sacrificed on the usual scale. The following clippings speak for themselves:

SNOWFLAKE, ARIZ., July 5.—Two children of Mr. and Mrs. John Dewitt, a girl, aged 8, and a boy, aged 4, were burned to death here late last night, when the Dewitt home was destroyed by fire. Two other boys, aged 10 and 12, who tried to rescue their brother and sister, were seriously burned. The parents were away from home at the time.

LONDON, ONT., Aug. 18.—Trapped beyond the reach of his mother while sleeping in a bedroom of their cottage home at 38 Hale Street, Ralph Edward Watson, three years old, was burned to death. His mother had just lighted a kerosene stove in the kitchen when it burst with an explosion that hurled the burning fluid about the room. Although painfully injured, she tried to reach the bedroom through the dining-room, but was cut off by the flames. She then rushed to the front door, but finding it locked attracted the attention of a neighbor.

BRANTFORD, ONT., Aug. 20.—Ethel Fletcher, five-year-old daughter of John Fletcher, 7 Huron Street, died in the hospital this morning from burns received when her dress caught fire while she was playing around a bonfire near her home.

MOOSE JAW, SASK., Aug. 21.—Gussie Mitchell, eight years old, is dead, and her mother, Mrs. J. Mitchell, is in the General Hospital in a critical condition, with little hope of recovery, as the result of an explosion of coal oil, which the little tot had poured on the fire in order to hasten its kindling last night. The girl was enveloped in flames, and passed away almost instantly. The clothes worn by the mother, who attempted a rescue, were completely burned off.

BURNS, ORE., August 31.—Fire, due to the overturning of a lamp, yesterday caused the death of three small children and the serious injury of the wife of Joseph Fine, rancher, near Crane, Ore.

CHAPELAU, Sept. 6.—While Mrs. Leyton Goodwin, wife of the C. P. R. telegraph operator at Nicholson's Siding, near here, went to call her husband to dinner, their little daughter Mona, aged three and a half years, was so seriously burned that she died shortly after being brought into the hospital here.

The little girl was playing with a baby brother on the floor of the kitchen. The children were playing with some old baggage checks with string attached and, according to the little boy's story, Mona put the string of one of the tags to the flame of the coal-oil stove on which the dinner was cooking. Instantly it caught fire and with it the child's dress.

FLINT, MICH., Sept. 13.—Attempting to rescue two little sons from a woodshed which they had set afire while at play, Mrs. Ray Hoagley, aged 26, was overcome by smoke and perished in the flames with the children.

The bodies of all three, the children clutched tightly in their mother's arms, were recovered from the ruins by firemen. The boys, Frank, aged 2, and Ray,

aged 3, had been playing in the shed, when their mother saw flames burst from the building. Dashing in at the door, she picked up one child, but tripped over the other, falling unconscious from the smoke.

Before assistance could reach her, the little building was all ablaze.

TORONTO, ONT., Dec. 12.—While playing with matches, little Sydney Beardmore, aged four, of 2 Markham Place, was badly burned from the knees to the eyes and rushed to the Hospital for Sick Children, where he died.

With his sister Mary, two years older, he was assisting to light a candle with a match, when his nightgown caught fire. The child started to go downstairs to the tap to extinguish the blaze when his mother, who is lying ill in bed, called him in and wrapped him in a blanket. Her hand was slightly burned.

BROCKTON, MASS., Dec. 29.—Two children of Mr. and Mrs. John Patutinskus, locked alone in the two-room home which their parents had improvised from a barn, were burned to death today in the destruction of the building.

The firemen arrived to find the shack burned flat, a pile of debris marking its site. It was at 620 East Ashland Street, in the outskirts of the city.

From beneath the wreckage, after streams of water had cooled it, were dug out the bodies of the infants. The almost incinerated forms, clasped in embrace, were found covered by the ashes of a bed and the charred straw of the mattress. Imprisoned in the sweep of the flames, they had evidently sought a place under the bed as refuge.

The children were 3 and 1½ years old.

No certain explanation of the fire is possible. The leading opinion of the firemen, however, is that it started from the fire in the stove. The rude home had no brick chimney, a long stove-pipe extending through the roof being the makeshift substitute. It is thought that the fire may have started through this arrangement. It is also a theory that one of the children may have set fire to her clothing with matches and that the other had clasped her in an endeavor to extinguish the flames.

FRANKLIN, N. H., Feb. 23.—Hazel, the seven-year-old daughter of Monson Cochrane, was burned to death early today when the Cochrane farmhouse in the Webster lake district was destroyed by fire. Three other children were saved with difficulty by Mr. Cochrane, who was severely burned about the face and body. The fire started from a defective chimney.

TUCSON, ARIZ., March 10.—Two children, brother and sister, burned to death in a fire which destroyed the farmhouse of their parents, Mr. and Mrs. Frank Webb, five miles from here. An older brother, 11 years old, set fire to a rug while playing in the absence of their parents, and ran from house, leaving smaller children to flames.

Lest the prominence of Canada in the above notes be misinterpreted, it should be explained that member M. E. H. Sailman, of Toronto, keeps a specially close watch upon these fires.

A number of deaths were reported as resulting from the use of kerosene to start fires, and oil lamps were held responsible for several more. At Lyons, N. Y., an aged woman fell while carrying a lighted lamp, and in a Syracuse, N. Y., lodging house the explosion of a lamp used to light the lodgers to their rooms and kept on a stand in a narrow hallway is believed to have caused a fire in which three men were burned to death.

The folly of entering burning buildings to rescue one's property is again demonstrated. At Lakeville, Conn., the owner of a garage lost his life in this way, and four Japanese were burned to death in Tacoma from the same cause.

An explosion of natural gas caused the destruction of four houses and the loss of nine lives at Bradford, Pa. A lantern held over an acety-

lene gas tank which was being refilled was responsible for an explosion which killed two men near Seneca Falls, N. Y.

A fatal fire at Holyoke, Mass., emphasises the importance of constructional features in tenement homes. In that case an oil heater exploded in a kitchen located between two bedrooms. There was no way of leaving either bedroom without passing through the burning kitchen. There were four deaths.

Although falling in a somewhat unusual category, the fate of a family of four who were suffocated in their sleep by fumes from their kitchen range is instructive as to the necessity of keeping ranges in good condition. As far as could be ascertained, the disaster was due to a defective key which permitted a damper to close, thus forcing gases through the top door, which had been left open when the range was loaded for the night. The kitchen in which the range was located adjoined the sleeping room in which the owner, his wife and two young children were overcome.

Institutional fires have a special interest inasmuch as the occupants are usually present without their own consent. The trapping of five unruly children in the Kent County Juvenile Home at Grand Rapids is a peculiarly flagrant example of how such institutions should not be conducted. The fact that ten boys were burned to death in a reform school at Marianna, Fla., in November, 1914, under circumstances painfully similar, shows how great is the responsibility of the authorities in respect of the supervision of the management of "homes" and reform schools. The circumstances of the holocaust at Grand Rapids are given in the following extract from the State Fire Marshal's bulletin:

GRAND RAPIDS, MICH., July 23.—Prosecuting Attorney Cornelius Hoffius, Tuesday, began an investigation into the fire that destroyed the Kent County Juvenile Home early Tuesday morning and caused the death of five children, the injury of three others, and possibly the loss of another child, who is missing.

But one fire escape was in the building, and some of the children on the third floor had been placed in their rooms and the doors locked with padlocks, it is alleged.

These children were classed as unruly, and it is said they picked ordinary locks. It was in this ward that the greatest loss of life resulted. The prosecutor in a statement Tuesday declared he intended to investigate all these phases of the tragedy.

Alleged social activities, which it is charged interfered with the management of the home, may also figure in the investigation. The contention is made that the matron, Mrs. Pauline Regester, was not in constant touch with affairs there.

The revised list of dead, injured and missing is as follows:

Dead—Hazel Rice, 8, 1256 Taylor avenue; Sybil Rice, 6, sister of Hazel; Richard Agema, 2, 225 Oakley place, N. E.; Oscar Hanley, 4; Lucy Hall, 12, Lowell.

Injured—Agnes Colen, 14, severe burns, perhaps fatal spinal injuries; Clifford Parks, 14, R. F. D. No. 4, Sparta, overcome by smoke; Joseph Sobczak, 12, 953 Davis Avenue, N. W., head cut.

Missing—John Sobczak, 10, brother of Joseph.

The fire is believed to have started from defective wiring in the laundry. The money loss will amount to about $25,000.

Two fatal fires in hotels are also worthy of notice. The first occurred at the Palace Hotel, Indianapolis, on February 8. The building was a three-story brick structure, housing about 42 persons on the second

and third floors. It was equipped with one iron fire escape, and the part of this which was supposed to swing automatically to the ground when the escape was used was found to be out of order. Some of the life ropes in outside rooms broke when an attempt was made to use them. The Fire Chief and the Assistant Chief who made an investigation after the fire expressed the opinion that with proper fire escapes the life hazard might have been greatly reduced. The fire occurred in a room containing rubbish which, some days previously, the fire prevention bureau had instructed the proprietor to remove. Two men were suffocated and eight so seriously injured that they had to be taken to the city hospital. As a result of the fatalities a campaign for more strict inspection of buildings in all parts of the city, and particularly of the downtown hotels, was instituted. It was reported that bad conditions were found in another hotel besides the Palace, and steps were taken looking to the issuance of closing orders until the necessary improvements had been made.

The scene of the second disaster was the village of St. Jovite in the Province of Quebec. Heating was by means of stoves on the first floor. It is believed that the stoves were located dangerously near frame partitions. The fire burned with great rapidity, and as it occurred between 2 and 3 a. m., it was not discovered until every means of escape except jumping from the second floor was cut off. Eight lives were lost.

Fire Protection for Schools.*

By H. W. Forster.
(Member N. F. P. A.)

[The N. F. P. A. Committee on Safety to Life is actively engaged in studying the school egress problem, and this Committee and the whole Association are actively interested in fire prevention and fire protection for schools. It is hoped that this article will prove a timely contribution in the effort to increase the safety of life in schools. The article is to be reprinted and will be available in pamphlet form.]

It is a far cry from the little red schoolhouse on the hill, with its one room, its handful of pupils, its chief fire hazard, the stove, out in the open where it is easily seen, its bucket of water, and its doors opening into the yard, to the modern city school, several stories in height, housing hundreds of children, and presenting complicated problems of fire prevention, fire protection and egress.

The property loss in schools has been large; the loss of life has been considerable; the fire risk in most existing buildings is great. The thought, energy and money put into furthering life and property safety in schools have not even approached that warranted by the jeopardy to the lives of the nation's greatest asset—our children.

While considerable improvement has been made in the last decade in the construction of new buildings, and also in the improvement of many existing structures, the fact remains that the large majority of schools in use today may become charnel houses instead of effective agencies of human advancement.

Business men who have created excellently safeguarded manufacturing and merchandising properties when serving on boards of education apparently do not view the American child as worthy of the same protection as buildings, machinery and goods. Possibly they argue that children can walk out of a burning building whereas goods cannot. Generally in event of fire the children do escape, but occasionally heaps of charred bodies of little children scathingly rebuke the judgment exercised and the parsimony practiced in the field of creating greater fire safety in schools.

Ignorance of even fundamental principles of fire prevention and fire protection on the part of those vested with the management of schools is one of the chief factors that make for the existing poor conditions. The general ignorance of the American public in this field is responsible for our tremendous annual fire tax and for the loss of several thousands of lives each year. This ignorance is particularly lamentable when it jeopardizes the lives of our children.

To a lesser, but nevertheless considerable extent, inertia, a feeling of the lack of responsibility and occasionally almost criminal disregard of known dangers result in action not being taken where, in a general way or even very specifically, the necessity for correction is known to exist.

* *Note.*—The facts presented in this article are as applicable to the colleges and universities as to the grammar and high schools of the country.

Poverty an Important Factor.

A discussion of fire safety in schools necessitates calling attention to the foregoing reasons for many of our unsatisfactory conditions, painful though such an arraignment may be to many entrusted with the management of educational institutions. It is only fair, however, to state that, important as are the factors of poor judgment, ignorance and failure to meet known responsibilities, the chief reason for our generally poor conditions undoubtedly lies in the almost universal poverty of our educational institutions.

Our schools must grow with the rapid growth of the country and with the increasing demand for better education on the part of our people. With few exceptions, every dollar that can be scraped together must be put into new buildings, additional equipment and increased teaching staff. The result is that fire prevention, protection and egress problems take second place.

Failure to meet the educational needs of the community results immediately in adverse comments from parents and from the press. The requirements of fire prevention, however, no matter how urgent their inherent need, seldom seem to be pressing. The good citizens who may urge action are commonly viewed as cranks. The likelihood is that during the tenure of office of a given school board no fire horror will take place in a school building under its control. Thus reasons the average director or trustee, and consequently fire prevention lags.

Gradual Improvement of Buildings.

No matter how great may be the poverty of an educational institution, it should not disregard any fire precautions that are relatively inexpensive, and it should spend at least a moderate sum each year for the gradual improvement of its most dangerous buildings. When the seriousness of the situation is generally recognized—and it is a fact that over 90 per cent. of our school buildings are potential death-traps—prosperous and philanthropic citizens will leave money to their alma maters and to the school systems of their cities for the furthering of fire prevention instead of for the addition of another building, frequently of inferior construction.

One source of revenue for the protection of school property which has generally been overlooked is a portion of the insurance premiums which in a large number of our school systems are saved by the adoption of a policy of self-insurance. School boards are not in the habit of creating fire insurance funds as do many corporations. The money simply is not paid out, and in event of a fire the taxpayers are called upon to make up the loss. Without arguing as to whether or not such a policy is good business, particularly in view of the danger of conflagration, the fact remains that if Boards of Education would take a substantial percentage of the insurance charge which could properly be made against school operations, and make use of that for the gradual correction of the more dangerous buildings, very excellent progress would be made in a decade.

Children Versus Dollars.

Secretary Franklin H. Wentworth, of the National Fire Protection

Association, in an address in Boston at a time when the reduction of building standards for public schools was proposed, stated that he felt confident that he could stand on the corner of Tremont and School Streets and in the course of a single afternoon, by appealing to the parents of the children who would be jeopardized in the poorer structure, collect enough money to make up the difference between the cost of a first-class building and of what was then being proposed.

It is preposterous to assume that this country cannot spend tens of millions of dollars, if necessary, to safeguard its school children. It is preposterous to assume that American communities require the experience of a Collinwood horror or a Peabody holocaust to prove to them the shortcomings of their school conditions.

The function of this article is not only to set forth the vital necessity of improving the conditions of our educational institutions, but also to point out specifically the problems which confront substantially every public school, private school, college or other institution.

The Essential Statistical Data.

At the present time there are in the United States approximately 300,000 buildings used for educational purposes, valued at more than $3,000,000,000. A very considerable number are erected each year, and it has been estimated that for every two new schools erected each year one is destroyed by fire. Some of the most important fires in educational institutions in the past two decades have been:

University Building, Nashville, Tenn., December 18, 1903.
Four-story brick building. Fire started at 11.00 p.m., probably from spontaneous combustion. Fifteen girls perished. No fire escapes.

St. Anne's Parochial School, Lawrence, Mass., November 22, 1905.
Caused by overheated furnace. Twenty-five girls jumped into life nets from third story.

Cornell University, Ithaca, N. Y., December 7, 1906.
Fire started at 4 a.m. Six killed and five injured. Loss, $300,000.

Hochelaga School, Montreal, Canada, February 26, 1907.
The fire started in a waste paper chute. Only one stairway. Kindergarten on second floor. One teacher and nine children lost their lives.

St. Joseph's Academy, Covington, La., November 30, 1907.
Caused by overheated radiator. One person killed. Loss, $100,000.

Public School, Monterey, Ind., December 27, 1907.
Fire caused by explosion of gasolene lamp. Two girls killed.

Father Baker's Protectory, West Seneca, N. Y., January 20, 1908.
Loss, $150,000.

Cornell University, Ithaca, N. Y., January 31, 1908.
Three-story building. One student killed. Loss, $25,000.

Lakeview Grammar School, Collinwood, Ohio, March 4, 1908.
Caused by steam main against wood joist in basement. Fire spread upward through basement stairway. Children well drilled, but became panic-stricken. One vestibule door on first floor bolted, and jam occurred here. One hundred and seventy-three children and two teachers burned to death. No fire alarm. Volunteer department called by passerby. Fire horses one mile from engine house when alarm sounded.

Paris High School, Paris, Texas, October 21, 1908.
Loss, $54,000.

Bliss Electrical School, near Washington, D. C., November 6, 1908.
Four-story wood building. No fire escape. Fire caused by leaky gas pipes. Lasted ten hours. Loss, $130,000.

Public School, West Chester, Pa., November 18, 1908.
Fire started in pile of coal in cellar. Loss, $55,000.

Alabama Normal School, Livingston, Ala., April 3, 1909.
Loss, $40,000.

Private School, Central City, Ky., May 22, 1909.
Five children burned to death during commencement exercises.

Phillips Model Business School, Paterson, N. J., June 1, 1909.
Loss, $16,000.

St. Anthony's Polish Parochial School, Jersey City, N. J., September 27, 1909.
Fireworks exploded in school. Door locked. Fifteen children injured, one killed.

Santa Clara College, Santa Clara, Cal., December 22, 1909.
Three- and four-story building, largely wood, completely destroyed. Loss, $100,000.

University College of Medicine, Richmond, Va., January 6, 1910.
Three-story brick building practically destroyed. Loss, $100,000.

New York Military Academy, Cornwall, N. Y., January 10, 1910.
Four-story wooden building destroyed. Two hundred students escaped because of efficient fire drill. Loss, $125,000.

High School, Ithaca, N. Y., February 14, 1912.
Loss, $200,000.

Public School No. 3, Rochester, N. Y., February 15, 1912.
Three-story brick and wood-joisted building destroyed. Fire started at 11.00 a.m., and more than seven hundred children escaped because of efficient fire drill. Loss, $50,000.

Northside High School, Minneapolis, Minn., June 18, 1913.
Two killed and nine injured.

College Hall, Wellesley College, Wellesley, Mass., March 17, 1914.
Fire started before daylight in chemical laboratory. Three hundred and fifty girls escaped because of excellent drill and roll call. Loss, $900,000.

St. John's Parochial School, Peabody, Mass., October 28, 1915.
Fire started in basement containing large amount of combustible material. Wooden partition at basement stairs burned through and allowed spread of flames through halls and unprotected stairways. No fire escapes. Twenty-one girls burned to death.

Stuart Hall, College of Emporia, Emporia, Kan., December 2, 1915.
Three-story stone, wood-joisted building totally destroyed. Loss, $100,000.

Penn College, Oskaloosa, Iowa, May 27, 1916.
Two persons killed and two injured.

Christian Brothers' College, St. Louis, Mo., October 5, 1916.
Building destroyed. Nine persons killed and eight firemen injured.

Central High School, Pueblo, Colo., February 28, 1917.
Building destroyed. Loss, $170,000.

Second Ward School, Kittanning, Pa., January 14, 1918.
Three-story brick building. Fire started in hot air ducts. Eight hundred and fifty children escaped. Loss, $75,000.

St. Mary's Industrial School for Boys, Baltimore, Md., April 24, 1919.
Entire group of buildings of ordinary construction practically a total loss. Two fire department lieutenants lost their lives and thirty-six firemen were injured.

The Actuarial Bureau of the National Board of Fire Underwriters, reporting only on fires where insurance was in effect, advises that for the two years regarding which complete information is now available the facts are as follows:

1916	No. of fires, 2321	Property destroyed, $4,337,690
1917	No. of fires, 2578	Property destroyed, 4,058,562

Because of the great extent to which schools carry their own insurance, it is certain that the total number of fires and the amount of losses have been greatly in excess of these figures.

No accurate records have been kept of the lives lost in school fires, or any other type of fires for that matter, and consequently exact data are not available. The most notable cases are shown in the tabulation above.

The reasonable life loss in relation to the exceedingly large number of fires is due to a large extent to the fact that a very large percentage of fires in schoolhouses occur outside of school hours, and is not due to the safety of the buildings themselves.

The Essentials of Fire Safety.

The essentials of fire safety for schools and, in fact, for practically all other structures, are developed more in detail later in this article. In order, however, that a clear grasp may be had of certain fundamental and commonsense principles, it is well to summarize in order that those interested may grasp the basic features of the whole problem.

Obviously the way to escape fire danger is to have no fires. That means fire prevention. Fire prevention has to do with removing the causes of fire, and covers the proper handling and storage of oils and other hazardous materials, the proper housekeeping measures, the disposal of waste of various kinds, the proper installation, inspection and maintenance of lighting and heating equipment, and attention to other similar fire hazards.

Many of these fire prevention measures are mechanical, but a far greater number depend upon human inspection and performance. It is regrettably true that the human factor cannot be depended upon, and that is chiefly why fire prevention measures alone are insufficient.

The next best thing to preventing a fire from starting is to see that any fire that starts is invariably extinguished while it is still small. The automatic sprinkler system is beyond question the most dependable device for accomplishing this, as is witnessed by a remarkable record of performance covering thirty-five years, which is summarized in the following statement unanimously passed by the National Fire Protection Association at its 1914 convention:

> "It is today an almost unquestioned fact that automatic sprinklers afford the highest degree of protection against fire in practically all cases where there is combustible construction or material, the rapid burning of which is liable to be a menace to the lives of occupants of the building."

Structural improvements and the use of fire-resistive building material in new buildings make possible a degree of safety in them which

cannot be secured in existing structures except by the application of automatic sprinklers.

Egress for Occupants.

Upon the carefulness and diligence which are exercised in fire prevention measures, and upon the provisions which are made for promptly extinguishing fire when fire prevention measures fail, depends to a considerable extent the problem of arranging for satisfactory egress. Obviously a one-story building with doors opening from every room directly to the outdoors has little in it in the way of egress problems. The egress difficulty in the multi-storied school is quite another question. The Committee on Safety to Life of the National Fire Protection Association is now developing the school egress problem in detail. Its preliminary report will be found in the 1919 *Proceedings* of the Association, and should be studied carefully by all authorities interested in this important matter.

Closely associated with adequate egress facilities are the suitable education and organization of those responsible for fire safety in schoolhouses,—the provision of automatic alarms, the systematic conduct of fire drills and the proper education of teachers and pupils.

There is necessarily a close interrelation between all of these various problems, and such interrelation should be borne in mind in reading the following sections of this article, which purposes to show the various common hazards which are found in schools and to outline the methods by which such hazards can be remedied or largely reduced.

The data presented are based upon investigation extending over a period of fifteen years, a detailed examination of several hundred schools located in different states, and a careful study of the available literature on this subject.

Causes of Fire.

The records of the Actuarial Bureau of the National Board of Fire Underwriters show the principal causes of fires in schools to be lighting, stoves and furnaces, chimneys, matches and smoking, and spontaneous combustion in various materials. The order does not necessarily indicate the jeopardy to life or the relative amount of property destroyed.

The ordinary grammar school or recitation building, containing only classrooms and a basement with heating equipment and storage rooms, has fire hazards limited largely to heating and lighting systems and to poor housekeeping. The more modern schools, and especially high schools and trade schools, contain the hazard created by the use of power-operated machinery, combustible working materials, inflammable liquids, chemical laboratories, etc. The following sub-divisions of the causes of fire present the principal facts which a school management should know in order to secure a considerable degree of safety.

Hazardous Materials.

Volatile Liquids.

Gasolene, benzine, alcohol and combustible metal polishes are commonly used by janitors and in connection with technical courses, for internal combustion engines, blow torches and cleaning machine parts.

Fig. 1. Inflammable volatiles stored in wooden cupboard. A broken or leaking bottle would allow liquid or vapors to spread with danger of ignition from spark or flame.

Their use should be restricted, the amount on hand reduced as much as possible, and necessary amounts should be kept in approved safety cans which are designed to prevent spilling, leakage or explosion. Main supplies, and even the safety cans when not in use, should be stored outside of the main building, unless there is a properly ventilated fire-resistive vault inside of the building. Only non-combustible metal polish should be used. (See Figures 1 and 2.)

Oils and Paints.

Lubricating oil, lard oil for cutting metals, linseed oil and turpentine for painting and wood finishing, paints, varnishes, kerosene for cleaning blackboards, and other inflammable liquids find their way into schools, frequently in astonishingly large quantities. (See Figures 3 and 4.) Some of these liquids are spontaneously combustible, all burn fiercely, and fire in them is hard to extinguish.

The main storage place for oils and paints should be a specially constructed oil house outside of main buildings. In cases where this is not feasible, a fire-resistive vault, properly drained and ventilated, should be used. Local supplies in the various workshops should be kept in metal cabinets provided with tight-closing doors and drip pans.

It is standard practice to use only electric lights in oil storage rooms, and such lights should be protected by vapor-proof globes. Switches for the lights should be located outside the room.

Floor oils should not be used at all in schools.

Motion Picture Films.

Motion pictures are being used more and more for educational purposes. While the danger connected with the use of motion picture films in theatres has been greatly reduced by the enforcement of strict regulations concerning fire-resistive booths, construction of machines, smoking, operator's licenses, etc., these same regulations are not always

Fig. 2. Open cans containing oils, paints, etc., stored in basement by janitor.

Fig. 3. Wooden barrels of oil on wooden platform; oil on floor; combustible storage close by and oil-soaked excelsior liable to spontaneous combustion.

Fig. 4. Oils, varnish, alcohol, turpentine and kerosene. What chance would there be of saving the wood-joisted building above, if fire once gained headway in this basement?

complied with in the public schools. For example, a motion picture machine was found in use set loosely upon boards supported upon the backs of seats, operated by an untrained person, and discharging film into a wicker basket. The ordinary motion picture films burn with a rapidity approaching an explosion and give off stifling smoke. Slow-burning safety films can be secured and are practically free from fire hazard. The use of motion picture films in public schools should be given the most careful supervision, and where inflammable film is used should be allowed only with approved machines, properly installed in fire-resistive booths, and attended by licensed operators.

Housekeeping.

While the number of fires directly attributed to housekeeping in schools is relatively low, poor housekeeping is so frequently a factor in the starting and spreading of fire that it is particularly to be avoided, especially as it costs nothing to maintain a high degree of cleanliness from a fire prevention standpoint.

Waste, Rags, and Mops.

Waste, rags and mops used for cleaning purposes are subject to spontaneous combustion, especially if oily, and should be burned immediately after use. Otherwise they should be kept in metal cans, or should be washed thoroughly and hung up. Clean waste and rags should always be kept in metal waste cans or covered metal barrels.

Waste Paper, Shavings, and Raffia.

Waste paper should be removed from the classrooms at the close of each school day, and should be burned, taken from the premises or baled. If baled to be sold, it should be stored after baling in an isolated building or fire-resistive vault. Teachers have been known to take loaded cartridges away from boys and deposit them in the waste paper basket. Live matches are also apt to find their way into the waste paper basket, and the best method is to remove the waste paper from the buildings as fast as it accumulates.

In smaller schools it is common practice to burn waste paper and rubbish in the backyard. A covered wire incinerator will prevent the blowing about of burning papers. Any fire should be carefully watched. In large schools these materials are frequently burned under the boilers, and it is sometimes feasible to install a special incinerator for this purpose.

Shavings are constantly accumulating in large woodworking shops. Fire spreads rapidly over floors and benches strewn with shavings. It is good practice to clean up the woodworking rooms between classes in order to keep the accumulation as low as possible. Shavings when swept up should be placed in covered metal receptacles and should be burned or removed from the buildings each night.

Raffia is used in many schools where courses are given in such work as hat and basket making. Supplies should be kept in covered metal containers or fire-resistive vaults and not in the unguarded manner shown in Figure 5.

Fig. 5. Raffia in storeroom adjoining classroom. Fire would gain headway very rapidly, filling classroom with smoke and flames.

Packing Material.

Packing material accumulates rapidly, especially in manual training schools where supplies are being continually received or finished work packed up for shipping. Packing materials should be disposed of as soon as shipments are unpacked, and all paper, excelsior and other combustible material that is kept on hand for packing purposes should be stored in a vault, in covered metal cans, or in covered metal or metal-lined bins. The covers of such bins should be equipped with stops so that they will always close by gravity. Where it is necessary to hold covers open for any length of time, this should be done by means of a fusible link.

Scenery, Decorations, and Booths.

In some of the more modern schools, especially in the high schools and colleges, auditoriums and assembly halls are provided with stages which are equipped with scenery for use in connection with amateur theatricals. In such cases the laws governing fire protection in theatres should be enforced. All scenery should be fireproofed, and a fireproofed proscenium curtain should be provided.

The use of holiday decorations in schools involves serious fire hazards. Christmas trees are probably the worst offenders, and in connection with these, candles, cotton trimming and the cotton suit and whiskers for Santa Claus should be avoided. Electric lighting should be used on the trees, asbestos or mineral wool should be substituted for the cotton, tinsel and glass should be used instead of paper garlands, and paper wrappings from packages should be removed as soon as possible.

In connection with fairs such as are held yearly in many high schools, the use of large amounts of combustible trimmings in crowded spaces is undesirable. Very often halls, libraries and gymnasiums are lined with booths which are completely covered with paper decorations. While the fairs are in progress these spaces are crowded with young people bent solely upon pleasure. Under such conditions exits are often inadequate and the fire danger great. Special extinguishing equipment

Fig. 6. Kindling wood and other combustible material in basement under wooden floor and close to unenclosed wooden stairway leading to main hallway.

should be provided in such cases, and uniformed policemen or firemen should be present to take charge in event of trouble.

Needless Combustible Material.

There is a case on record where a thorough house-cleaning of a group of public school buildings resulted not only in a material reduction of fire hazard, by virtue of the elimination of tons of needless combustible material, but also brought to light furniture and other school equipment which, when cleaned and repaired, represented a value of six thousand dollars. New equipment needs were consequently reduced by this amount.

At least once a year every school should be gone over as regards roofs, attics, classrooms, closets and basements in order to make certain that every bit of rubbish and unnecessary material is removed. (See Figure 6.) For the ordinary-sized city an abandoned school makes an excellent general storehouse for material and equipment not in active use in the schools.

Lockers.

The modern tendency is to provide central locker rooms with metal lockers in place of the old wardrobes and hall lockers. New lockers, no matter where located, should be of metal and have solid backs and side partitions to prevent spread of fire between them. Screen or punched plate doors are preferable to admit of inspection without unlocking.

Electricity.

The insurance interests report that in 1916, 86 fires from electrical causes resulted in a loss of $585,054. In 1917 the number of fires was 70, with a property loss of $500,307. Electrical fires are therefore a very definite hazard in schools. The National Electrical Code as issued by the National Board of Fire Underwriters contains specifications covering every detail of electrical installation, and compliance with these specifications will eliminate practically all fire hazard in connection with electrical equipment.

In grammar schools the electrical equipment consists mainly of wiring, lamps, switches and fuses. In the larger schools, however, especially in high schools and technical schools, the hazard is increased by the installation of rheostats, motors and various types of electrical heating devices. Some of the larger schools even operate generating systems. Only the most common electrical hazards are discussed herein.

Protecting Circuits.

Electric wiring should preferably be installed in conduit throughout.

Courtesy Safety Engineering.

Fig. 7. Unusual electrical hazard. Rat gnawed away insulation on telephone wires and caused short-circuit which killed him. If current had been of higher voltage a bad fire might have occurred.

Where open wiring is used there is always the possibility of mechanical or other injury. Figure 7 shows one of the unusual ways in which fires may start. Another reason for properly protecting wires is shown in Figure 8.

Pendant and Portable Cords.

The insulation on twisted pair cords deteriorates very quickly, and when in contact with metal there is danger of a short circuit which will start a fire. (See Figure 9.) Portable cords should be used sparingly and should be of the heavy reinforced type, with a strong guard for the lamp.

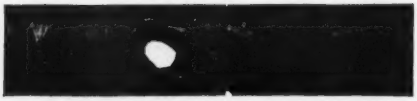
Lamps.

The ordinary incandescent lamp gives off heat enough to be a serious fire menace. Wherever there is danger of lamps coming in contact with combustible material or being broken, they should be enclosed in substantial wire guards securely clamped to the lamp socket.

Combustible shades, often of paper or cardboard and sometimes even of celluloid, are found on pendant lamps, especially where these are used about machines. Where shades are necessary they should be of metal.

Heating Units.

Heating units, such as flat irons, hot plates, glue heaters and occasionally stoves, found in domestic science and manual training departments, should receive special attention, as they have a bad fire



Courtesy Safety Engineering.

Fig. 8. Gas pipe melted by electric arc. Rubber covered wire rested against this pipe in basement. It became grounded, melted pipe, ignited gas and caused fire.

record. A red pilot light should be installed in the circuit with each heating unit, or connected series of units, to serve as a danger signal whenever the current is turned on. Metal or asbestos stands should be provided for irons, and proper air space should be maintained about all heating units.

Fuses.

Fuses are the safety valves of the electrical system and should be installed at the point where the wires enter the building and on each branch circuit. Open link fuses are still used in some of the old schools, and frequently cases are found where janitors or teachers have replaced blown fuses with copper wire, nails, or any other conducting material that happened to be handy. Such conditions subject the entire circuit to possible overloading and have caused many fires.

Stereopticon Lanterns.

Stereopticon lanterns generally require too much current to admit of their being installed on an ordinary lighting circuit. Where they are used it is therefore generally necessary to provide special connections.

Gas Lighting and Heating.

The essential features to secure safety from gas lighting, other than care in handling matches, are:

a. Proper clearance over mantles and burners. Three feet is ordinarily necessary with a Welsbach mantle and two feet with a flat flame burner. Lesser distances than this require heat bells.

b. No swinging brackets where flames can come into contact with any combustible material.

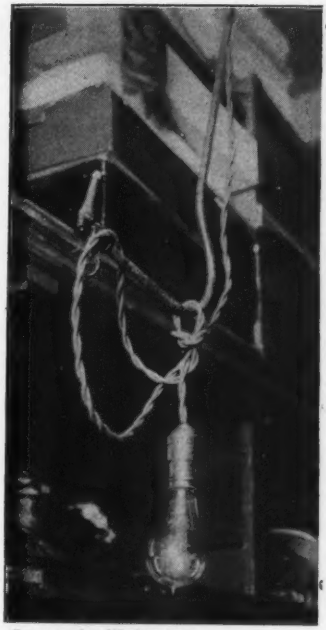
c. Wire guards for flames to prevent people and materials from coming in contact with them.

d. Elimination of key control for gas lights where pupils might play with them.

Gas Stoves and Heaters.

Some of the hazards connected with the installation and use of gas stoves and heaters are common to other types of heating apparatus and will be discussed in another section. Rubber tubing, very commonly used for connecting gas stoves and heaters, should be absolutely prohibited, and with the possible exception of connections for Bunsen burners on benches in laboratories only permanent piping should be used.

Main control valves should be provided for all series of burners



Courtesy Jay W. Stevens.

Fig. 9. Electrical hazard in store room. Insulation in contact with metal deteriorates, and a short-circuit is likely to start a fire.

and heaters in laboratories and domestic science rooms for emergency, night and vacation use.

For lighting gas lights and heaters a metal friction lighter gives excellent service with no fire hazard. The general use of matches for this purpose should be prohibited.

Pilot lights are frequently provided for lights and heaters, especially hot water heaters. The accidental extinguishment of such pilot lights, followed by the escape of gas for a considerable period of time, has been the cause of numerous explosions. Consequently such heaters need stovepipe connections to separate chimney flues.

Kerosene Lamps.

Kerosene is still used extensively for lighting in rural schools. The oil vapor in the bowl of kerosene lamps may explode if the burner does not fit properly and if the wick is not of correct width and ample length. Glass fonts are often broken, allowing burning oil to spread. A broken chimney may allow the flame to come in contact with combustible material.

Good practice requires that kerosene lamps be cleaned daily, that burners be kept clean, that wicks be of proper width and length, and that filling be done only by daylight. Occasionally through error gasolene has been put into kerosene lamps with resulting explosions and fires.

Lightning.

In 1916 lightning started 376 schoolhouse fires in the United States, with a total loss of $61,811.00. In 1917 there was a loss of $199,789.00 as a result of 499 fires. Not a building that was struck was provided with lightning rod protection. Contrary to the common opinion, a lightning rod installation, properly designed and installed, affords decided protection for exposed buildings.

Heating Hazards.

The records of the Actuarial Bureau of the National Board of Fire Underwriters show the reported school heating hazard fires to have been as follows during the years of 1916 and 1917:

Fig. 10. Result of poor chimney construction. Floor attached to chimney having only 4-inch walls and no lining. Fire destroyed building.

Fires Caused by Heating Systems.

	1916.		1917.	
	No. of Fires.	Loss.	No. of Fires.	Loss.
Stoves, furnaces, boilers, and their pipes	318	$464,814	307	$645,725
Chimneys, flues, etc., overheated or defective	296	430,370	247	301,365
Hot ashes and coals, open fires	56	32,277	64	37,501
Steam pipes	2	25	7	1,008
Total	672	$927,486	625	$985,599

In the operation of stoves, care of stovepipes and chimneys, and disposal of ashes, janitors are prone to be careless. The fire dangers involved are so severe as to merit careful and regular supervision.

Chimneys.

It is amazing to note the indifference of most people to fire hazards of this type. The cutting of construction expenses by setting beams and floor joists into the brickwork of chimneys is poor economy, as witnessed by Figure 10, which shows a chimney with 4-inch brick walls into which woodwork had been let.

The minimum specification for a brick chimney in a building of more than one story is 8-inch walls and a flue lining. For one-story buildings

Fig. 11. The bonfire is laid close to the furnace. A hot coal—a spark even—would light it.

with an ordinary stove a 4-inch chimney with flue lining may be built directly on the ground. All chimneys and pipes should be thoroughly cleaned each fall before fires are started.

Stoves, Furnaces, and Boilers.

The hazard of cracked stoves and of poorly supported stovepipes with open joints is obvious. While stoves and furnaces should be operated in a manner to prevent overheating, they should be so located that serious overheating will not set fire to the building or nearby storage. (See Figure 11.)

Any woodwork heated to 150° C. or over for any length of time is liable to ignite, and all heating apparatus must be installed with this fact in mind. (See Figures 12 and 13.)

Boilers and furnaces should always rest directly on the ground or on absolutely incombustible construction; never on wood, even if protected.

Where stoves must be placed on combustible construction, they should be raised on legs or supported beams at least 6 inches and preferably 12 inches from the floor, ventilation being thus afforded.

Floors should be protected over a liberal area with metal on asbestos.

Proper clearance overhead where floor above is of wood will vary with the heating device, but should not be less than 2 feet with a furnace and 3 feet with a boiler. For stovepipes the minimum clearance is generally placed at 12 inches, although 18 inches is better. Ample clearances from wooden walls and partitions is as important as adequate headroom.

Other Heating Devices.

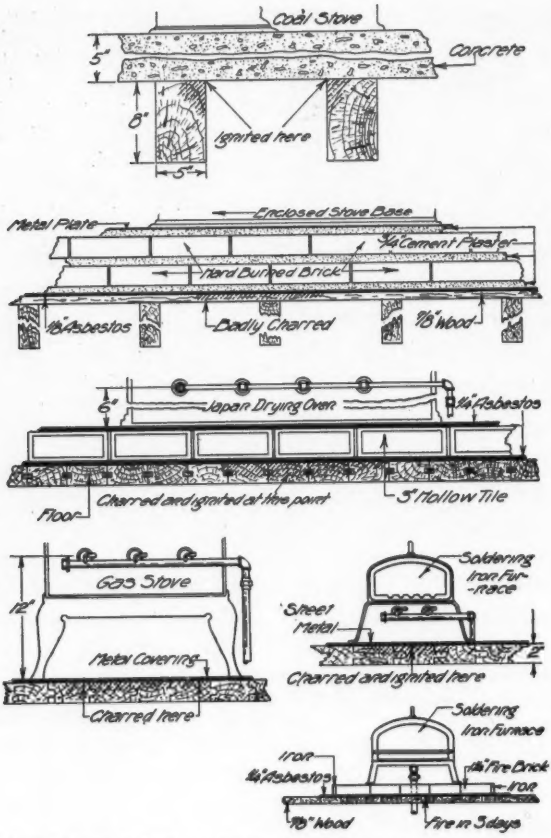
In addition to the usual heating devices, schools are likely to have in them hot plates used in domestic science courses, glue heaters in woodworking shops, forges, annealing furnaces, and blow torches in blacksmith and machine shops, stoves, mangles and irons in laundries, and gas heaters at lunch counters. In connection with all of these there are fire hazards which must be guarded against.

Some isolated schools do not have gas available for use in domestic science courses, and if kerosene stoves are used they should be of the standard blue flame type with removable reservoirs, so that these may be filled outside.

Under no consideration should gasolene be used for heating, lighting or cleaning purposes.

Ashes.

Ashes, apparently cold, are responsible for many fires, and the danger is increased materially by mixing combustible rubbish with them.



Courtesy Crosby-Fiske-Forster Handbook of Fire Protection.

Fig. 12. Fires due to improper installation of heating devices. To the layman any of these six installations would have appeared perfectly safe.

Ashes while inside of buildings belong in covered metal cans or on cement floors away from woodwork.

Steam Pipes.

The possibility of fire occurring through contact of hot steam pipes with woodwork is questioned by many, but the danger has been definitely established. In the case of the Collinwood School fire, the official verdict was that a steam pipe passed through a closet near the foot of the stairs and was undoubtedly the cause of the fire which destroyed 175 lives. Proper insulation or air space should be provided about all steam pipes where they pass through floors or partitions. Where air space is relied

Fig. 13. In spite of 6-inch air space under gas plate burners, the zinc table covering was melted and the wood badly charred.

on for safety, pipes should be centrally supported in the openings. Where there is danger of combustible material coming in contact with the hot pipes, guards should be installed or the pipes should be covered with insulation. In cloak rooms, where clothing is apt to hang against radiators, these should be protected with wire screen guards.

Heat of the Sun.

The rays of the sun passing through water bottles, fish bowls, paper weights, spectacles, bubbles in window glass, and reflected from microscopes or other concave reflecting surfaces have caused a considerable number of fires. Children also have a habit of experimenting with burning glasses and of burning their initials into desks and books. The remedy lies in keeping possible lenses out of direct sunlight and in not permitting children to experiment with burning glasses in school.

Matches and Smoking.

The insurance reports indicate that the smoking and match hazards were responsible in 1916 for 118 fires involving a loss of $204,726, and in 1917 for 274 fires involving a loss of $259,287. In spite of the efforts of school authorities to the contrary, boys steal away to smoke, and naturally go to unfrequented places, which increases the fire hazard. Hastily discarded matches and cigarettes carry with them a very considerable danger. Janitors also frequently smoke in basements of schools while they are in session. It is obvious that smoking should not be allowed on school property at any time.

Children should not be allowed to bring matches to school with them. Where matches must be used in the course of school affairs, they should be of the safety type. For gas lighting regular friction lighters should be provided.

Fire Extinguishing.

It is startling to see how little provision is made for fire fighting in the average school. It is even more startling to observe the poor upkeep of equipment and the ignorance of the janitors and the faculty as to its use. Extreme instances of this perhaps are the case of a school for mentally deficient children, where the fire inspector was held in the office of the principal until the janitor could fill the few pails of which the school boasted, the hastily drawn *warm* water proving the duplicity of the principal, and the case of a school for crippled children in which a few obsolete heavy extinguishers which no one knew how to use were all

that could be relied upon to put out an incipient fire and save scores of helpless children, some of whom were as high up as the third floor.

Life loss possibilities and property protection necessities make essential at least reasonable fire-fighting equipment in all buildings and automatic sprinkler protection in many dangerous structures.

Public fire departments, important as they are from a property protection standpoint, are relatively unimportant as life protection factors. Between the time the fire breaks out and the beginning of life-saving activities by the department many minutes always elapse, even in large cities, and the first few minutes may suffice for a large life loss.

For isolated country schools, especially of the college type, good water supplies, fire mains, hydrants, hose, ladders and other equipment are essential for property protection purposes, but the features of such a protection system will not be discussed here, as that is an intricate engineering problem, varying greatly with the conditions. This article will be confined to the fire-fighting equipment which may go into the school building proper.

Automatic Sprinklers.

Some school boards and principals either have not understood the value of sprinklers or have been prejudiced against them, but in many of the older schools automatic sprinklers are the logical answer to the problem of securing greater life safety. Unfortunately, in many cities conditions are such that the best proposition by no means goes through, as witnessed by the notorious case of a certain city which suffered a serious loss in its schools and which invested funds, sufficient to provide adequate sprinkler protection, in an installation of stamped metal ceilings.

While the school buildings should be equipped with hand extinguishing apparatus, the ordinary school over one story high, if of combustible construction, needs automatic sprinklers, and needs them badly.

Frequently an installation of sprinklers will furnish a sufficient degree of protection to render unnecessary expensive structural changes that would otherwise be imperative in the interests of safety.

The sprinkler, if properly maintained, is on duty day and night, goes into action as soon as the fire reaches modest proportions, is not affected by smoke as are human fire fighters, and can be arranged to give an alarm the moment water flows from the sprinkler system. (See Figure 14.)

Sprinkler heads are made with a special solder which melts at about 160° F., which is less than the boiling point of water. The sprinkler has a ½-inch orifice or nozzle and a deflector, and under usual pressures will discharge 15 to 20 gallons of water per minute in the form of a drenching spray over an area of perhaps 15 feet in diameter. As the sprinklers are seldom placed over 10 feet apart, these spray circles overlap, and a fire has little chance to burn or spread.

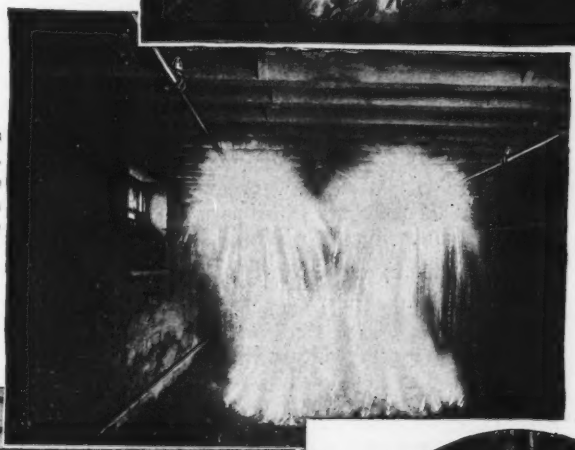
Instances of Sprinklers Installed in Schools.

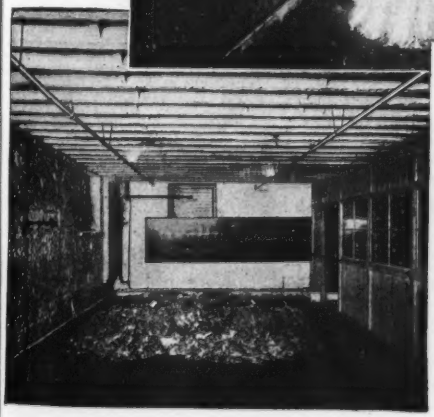
It is gratifying to know that a considerable number of sprinkler equipments have been installed in schools, as indicated by the following partial list arranged alphabetically by states:

Watching the Water Distribution.

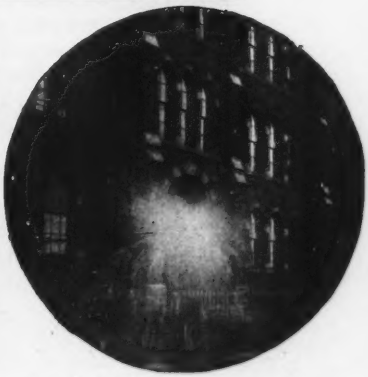
The Start of the Fire.

Sprinklers Operating. When the Fire Starts the Water Starts.





Fire Extinguished Without Any Human Aid.



How a Sprinkler Looks in Operation.

Courtesy General Fire Extinguisher Co.

Fig. 14. Illustrations of Sprinkler Operation in a Cleveland School.

College of Dentistry, Los Angeles, Calif.
Westover School, Middlebury, Conn.
High School, South Manchester, Conn.
Georgia School of Technology, Atlanta, Ga.
Columbus Industrial High School, Columbus, Ga.
Northwestern University Medical School, Chicago, Ill.
Washington School, Evanston, Ill.
Notre Dame University, South Bend, Ind.
Holy Cross College, New Orleans, La.
Baltimore Public School, No. 63, Baltimore, Md.
Massachusetts Institute of Technology, Boston, Mass.
Harvard College, Cambridge, Mass.
Lowell Textile School, Lowell, Mass.
State Normal School, Salem, Mass.
Michigan Agricultural School, E. Lansing, Mich.
Diamond School, Grand Rapids, Mich.
University of Minnesota, Minneapolis, Minn.
Lincoln High School, Jersey City, N. J.
Erasmus Hall High School, Brooklyn, N. Y.
Buffalo Schools (Central High), Buffalo, N. Y.
Cornell University, Ithaca, N. Y.
Columbia University, New York, N. Y.
School for Deaf and Dumb, Morgantown, N. C.
Warsaw School Building, Cincinnati, Ohio.
Cleveland Manual Training School, Cleveland, Ohio.
St. Clair School, Cleveland, Ohio.
Creston School, Portland, Oregon.
Metropolitan Dramatic School, Philadelphia, Pa.
Swarthmore College, Swarthmore, Pa.
Brown University, Providence, R. I.
Technical High School, Providence, R. I.
Buford College, Nashville, Tenn.
Texas Textile School, College Station, Texas.
High School, Ashland, Wis.
University of Wisconsin, Madison, Wis.
McGill University, Montreal, Quebec.

Partial Installations Frequently Advisable.

In cities where it is impracticable for financial reasons to install the full equipment considered desirable, the following procedure may be adopted:

(*a*) All school buildings which are under the jurisdiction of the board which is considering sprinkler protection should be listed in the order of their relative danger to life, taking into account construction, exits, operations carried on therein, and any other essential factors.

(*b*) Sprinklers should be provided in the basements of school buildings in the order of their standing on the relative hazard scale.

(*c*) These sprinkler systems should all be arranged so that they can later be extended to upper floors of the building.

(*d*) After basements of all buildings, except the very finest, modern, incombustible ones, have been equipped, the installations should be extended upward, again beginning with the more hazardous on the list.

(*e*) In this manner a given amount of money will be used most effectively, and ultimately all combustible schools can be fully protected.

The reason for this proposal will be evident upon reflection. Fires above people seldom jeopardize their lives. If there are two ways out of a given room, a fire on the same floor is not a very serious matter, assuming that all rooms are occupied, fire promptly discovered and alarm given. On the other hand, fires below persons, and particularly fires in the basement where rapid spread has unfortunately been the general rule, are most to be feared. Practically all persons are above a basement fire, and fires spread upward far more rapidly than horizontally or downward. The Collinwood and Peabody life loss resulted from basement fires.

There has been altogether too much tendency on the part of a school board to find that it would cost tens of thousands of dollars to install sprinklers throughout the schools in the city and to assume that because the whole sum was not forthcoming no beginning should be made. If sufficient funds can be found to sprinkler the basement of the worst building a worth-while step will have been taken.

Inside Hose Protection.

In high schools and colleges, especially where these are without public protection, there is generally advantage in an installation of inside hose, provided that there are trained persons to use the equipment to advantage.

In all schools a hose connection should be provided in the boiler or furnace room to wet down ashes and to use on incipient fires.

Chemical Extinguishers.

Approved extinguishers of the soda and acid type should be distributed throughout all school buildings. From any point in any school corridor at least two fire extinguishers of this type should be plainly visible, and they should be located not more than 100 feet apart. At least one extinguisher should be placed in each laboratory, woodworking shop, basement or other place where there is any special hazard.

Special liquid extinguishers may be valuable in special locations for fires in oils, grease or electric equipment, as they function chiefly by the generation of a gas blanket which excludes oxygen from the flames.

It is, of course, essential that the teachers and older pupils should understand the operation of the extinguishers and that the maintenance of the apparatus should receive constant skilled attention.

Gasolene has been found stored in empty cans in which special extinguishing fluid had been shipped, and all empty cans should be destroyed promptly upon being emptied.

Water Pails.

A pail of water is the oldest, cheapest and most generally used fire extinguishing agent. It is difficult, however, for anyone, and especially for children, to throw water accurately from a pail for any distance, and it is advisable, therefore, to install water pails chiefly in basements, woodworking shops, storerooms, and attic spaces where burning material is likely to be on or near the floor.

Pails should be filled with clean water and regularly inspected. To paint them red, stencil them "For Fire Only," and reserve them strictly for fire-fighting purposes is the usual rule. Pails should preferably be of 10-quart capacity. Wherever there is danger of freezing during cold weather this can be eliminated by dissolving a proper quantity of calcium chloride in the water.

In basements and attic spaces it may be advisable to install barrels filled with water, hanging two or three pails over each.

Sand Pails.

Sand is an effective extinguisher of fires in oil or electrical equipment, but should never be used about motors or generators because of possible damage to equipment. Sand pails, provided with scoops for scattering the sand, should be placed near switchboards and similar electrical apparatus and close to all storage places for oils and paints.

Dry Powder Tubes.

Tubes filled with bicarbonate of soda are to be found in many of the older schools. If a theater attendant at the time of the Iroquois disaster had used a "soda and acid" extinguisher instead of trying to use a dry powder tube six hundred lives might have been saved. The best rule is to discard all dry powder tubes.

Hand Grenades.

Hand grenades are of little more value than the dry powder tubes, and should be discarded whenever found.

Blankets.

A heavy woolen blanket should be provided for each chemical laboratory or domestic science cooking room to smother fires in clothing.

Fire Brigades.

Fire brigade organizations among pupils should be limited to older boys, carefully selected. These should be organized and trained under the direction of an experienced fireman to handle whatever equipment is available. Organizations will necessarily vary to meet the local needs, but, generally speaking, there should be at least ten members. These boys should be thoroughly instructed in the principles of fire prevention and fire fighting and drilled about once in two weeks.

From an educational standpoint it is very important that as many boys as possible receive the benefit of fire-fighting training. For this purpose it is good practice to rotate the membership.

Egress for Occupants.

The fatuous faith of the majority of school authorities and laymen in the life-saving power of outside fire escapes is a constant source of wonder and pain to the student of fire protection for schools. Some escapes are wide and properly railed; the stairs have an easy pitch; access to them is direct; they lead to the ground; they are located opposite blank walls or pass windows protected with metal frames and wired glass; they are a valuable means of egress if used. The large majority of fire escapes, however, are a delusion; they may prove death-traps. (See Figure 15.) Narrow, steep, reached by climbing over window sills, terminating many feet from the ground, passing windows out of which flames are likely to pour, never used at times of drill, they are a monument to the ignorance of the authorities and the selling ability of the manufacturers. An outside fire escape on a school building is generally an admission of the inadequacy of its normal exit facilities.

A one-story school such as that shown in Figure 16 has ideal egress facilities. No group life loss is possible under such conditions. The conditions in the Collinwood School, shown in Figure 17, where 175 lives were lost, were similar to the present situation in thousands of our schools. Each school problem needs careful study to the end that adequate egress facilities may be provided and that these facilities may be promptly and intelligently used.

Building construction, height, enclosure of stairs and provision of automatic sprinklers all have a bearing on the amount of stair capacity that a building requires. The preliminary report of the Committee on Safety to Life of the National Fire Protection Association, to be found in the 1919 *Proceedings,* is the forerunner of an ultimate practical plan for adjusting the egress requirements to the building with due regard to its structural and protective conditions.

Fundamentals of Good Egress.

It should be possible to empty a school building of ordinary height and ordinary construction in not more than three minutes; two are preferable. Elements that need consideration are:

(*a*) An alarm system for prompt notification of fire or of drill.

(*b*) Proper individual room aisles to admit of quick marshalling of children.

(*c*) Adequate door or doors to corridors, to inside stairs directly, to other rooms, or to outside towers or escapes.

(*d*) Sufficiently wide, straight, unobstructed halls.

(*e*) Stairs ample as regards number and of proper width, handrails, preferably enclosures, and separations to protect against smoke blocking all stairs.

(*f*) Direct exit from stairs to outside without forcing pupils to enter lower halls.

(*g*) Special egress facilities for auditoriums, gymnasiums, lecture rooms, and other points where large numbers of persons congregate.

(*h*) Carefully planned and frequently held egress drills.

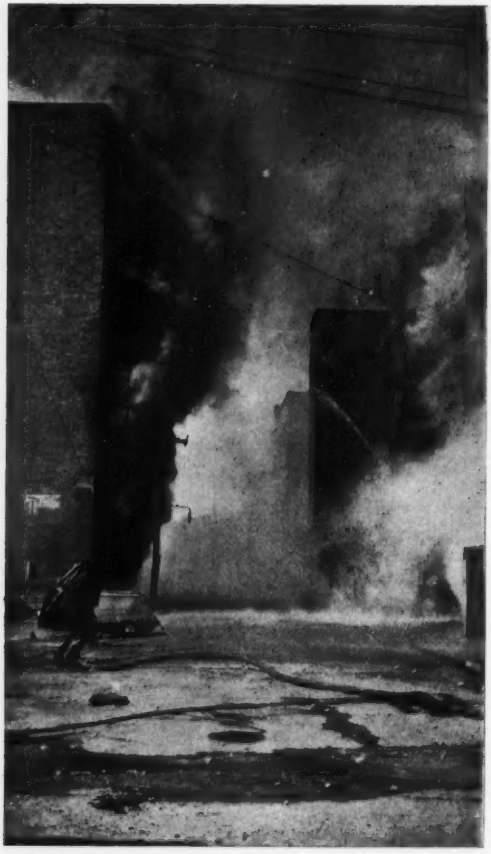


Fig. 15. Not one person could pass down this fire escape because of smoke and flames. Bodies of some of the 33 girls who perished were roasting on the fire escape when this picture was taken.

It should be borne in mind that in many cases schoolhouses serve the purpose of community centers and are used for public meetings.

Alarm Systems.

All school buildings, with the possible exception of small one-story structures, should be provided with a dependable means for giving prompt alarm at time of fire. In small buildings of more than one story a vertical rod from basement to top floor, provided with an operating handle at each floor and connected to one or more large gongs, will answer. In larger and more complicated buildings, however, it is necessary to use electrical systems. Gongs should be so located that they can be heard plainly in every portion of the building, and one signal station for every twelve rooms is a fair standard, although this will, of course, be varied according to arrangement.

Thermostats.

Approved thermostatic (automatic) fire alarm systems operate on a moderately rapid increase in temperature. Such systems are similar in action to an automatic sprinkler system, but lack the extinguishing feature. Probably for this reason their installation has been limited to cases where there was a keen interest in fire protection, but where funds were not available for the installation of automatic sprinkler systems.

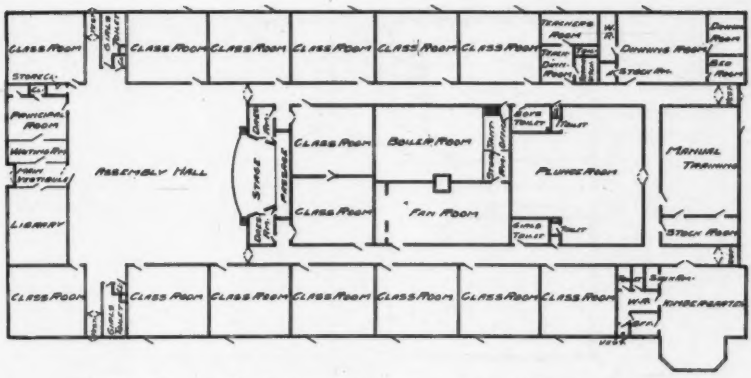


Fig. 16. Plan of a single story school. School No. 24, Rochester, N. Y.

Sprinkler Alarms.

Where automatic sprinkler systems are installed fire alarm can be automatically given by means of a water flow alarm valve connected to gongs throughout the building. This is probably the most efficient fire alarm system devised, as the starting of the fire, operation of sprinkler head to extinguish it and the sounding of alarm are almost simultaneous.

Standard Signals.

The number of rings used as fire alarm signals vary in different localities, but the 4-4 signal is considered standard, and it is recommended that this be used throughout the country. Especially should the same signal be used in all schools in any one city, as teachers and pupils are apt to change frequently.

City Fire Alarm Boxes.

The location of the nearest city fire alarm box and method of operating this should be understood by teachers and older pupils. If there is not a city fire alarm box within a block of a school building, a special box should be installed near the main entrance.

Means of Egress.

Individual Room Exits.

In the opinion of many good judges all classrooms, laboratories, etc., should preferably have two exits, one leading to the corridor or to an inside stairway directly, and the other to a similar stairway, a fire tower, an outside escape, or an adjoining room from which a second means of egress can be reached. On the other hand, some are inclined to think that the single exit in buildings of good construction has an advantage from the viewpoint of maintaining discipline in time of panic.

In many cities portable one-room school units are in use, and these frequently are provided with but one exit, which is generally used to connect them to the main building. A separate outside exit should be provided.

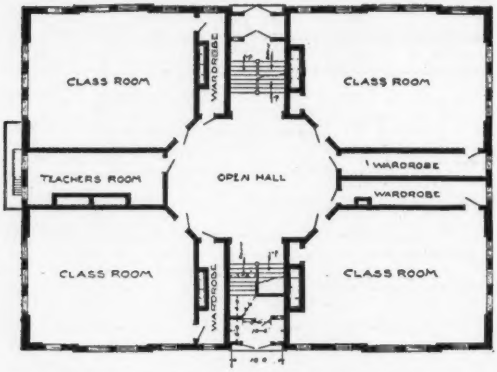


Fig. 17. Lakeville School, Collingwood, Ohio. First floor plan from the front. Compare measurements and arrangement of vestibule, where 173 children perished, with conditions in your community.

School basements, especially where basement rooms are used as classrooms, should have exits leading directly to the outside.

Corridors.

One acceptable rule regarding corridor widths is 8 feet for a building having eight classrooms on a floor, and one foot more or less for every two rooms above or below this figure. The corridors should not terminate in dead ends.

Stairways should preferably be located at all turns or ends of corridors. Sloping floors or ramps should be avoided where possible and, if necessary, their pitch should not exceed one foot in eight.

All openings which subject corridors to serious exposure, such as windows overlooking combustible roofs or doors communicating with laboratories, woodworking rooms and other hazardous places, should be protected by wired glass in metal sash or by fire doors.

Larger Meeting Rooms.

The necessity of adequate means of egress from auditoriums, gymnasiums, lecture rooms, laboratories or other places of general assembly is evident. Where not located on the ground floor, there ordinarily should be separate exits leading directly to the outside. Doors should open outward and be kept clear of chairs and other objects.

Number of Stairways.

The stairway arrangement of every school, old or new, should meet the fundamental rule of at least two ways of egress being available from any class or assembly room. The arrangements should be such that there is only a remote chance of both exits being cut off by smoke or fire at the same time. The more common arrangement, of course, is to have two stairs connected with the same corridor into which, in turn, all

Fig. 18. Clothing hung in halls and stairways may be knocked down and cause children to stumble, fall, and pile up.

rooms open. If two such stairs are fairly close together, they cannot be properly considered separate means of egress unless enclosed in fire-resistive or fire-retarding partitions equipped with smoke-proof doors.

Account must be taken of the possibility of one stairway at least being blocked by fire or smoke, the other or others being called on to provide adequate egress under those conditions.

It is commonly assumed that a standard 4-foot or 5-foot inside stair will pass in drill formation 120 pupils per minute, or 60 in each of the two lines. To be conservative, this figure should be reduced to about 45 per minute per file past a given point.

Stairway Construction.

Measured between handrails, the width of stairways should never be less than 3 feet and never more than 5 feet unless intermediate handrails are provided. In new construction the best practice is to have the stairs 4 feet wide. Stairways should preferably be incombustible, and should be kept absolutely free from obstruction. (See Figure 18.)

The stairway plan should be simple, and stairs should be of uniform width throughout their length. (See Figure 19.) Winding stairs should never be permitted.

Handrails.

Handrails should be provided at both sides of all stairways and also at intermediate points where more than one double column of pupils is to be accommodated. Ends of rails should be curved to prevent pupils running into them. Balustrades should be at least 3 feet high.

Fire Escapes.

Adequate exit in new buildings should preferably be secured without resorting to fire escapes. On many existing buildings, however, fire escapes are necessary because of the inadequacy of the inside stairways. Where necessary, their construction and installation should be in accordance with the National Fire Protection Association rules.

Fire escape stairways should extend to the ground. Where for any reason it is not possible to continue the stair to the ground, a counter-

Courtesy Division of Education, Russell Sage Foundation.

Fig. 19. Dangerous stair construction. Three stairs join on narrow landing and assembly room doors open directly upon stairs, without landing. All stairways are unenclosed and terminate in long corridors.

balanced section is necessary. (See Figure 20.) Contrast that with the conditions presented in Figure 21.

Smokeproof Towers.

The Philadelphia Fire Tower in its various modifications provides the safest means yet devised of egress from upper floors of buildings. The stairway is cut off from the building by fire walls and fire doors, making it impossible for either smoke or flames to enter the tower. (See Figure 22.)

Such towers can serve every normal stairway need in all save extremely cold climates. Scores of schools in North Carolina have only smokeproof tower stairs.

Doors and Gates.

Had the one bolted door of the pair of doors at the foot of the Collinwood School stairs been open, the children might have passed through to safety. All doors provided should be adequate for the number of occupants and, with the possible exception of individual classroom doors and doors on fire walls, should swing with the travel. Doors should never be bolted during school hours except by means of approved panic bolts.

Gates should be avoided wherever possible. If absolutely necessary, they should be locked open during school hours. (See Figures 23 and 24.)

Horizontal Egress.

In planning new school buildings of large area, these should be sub-divided by one or more approved fire-resistive partitions. Even in

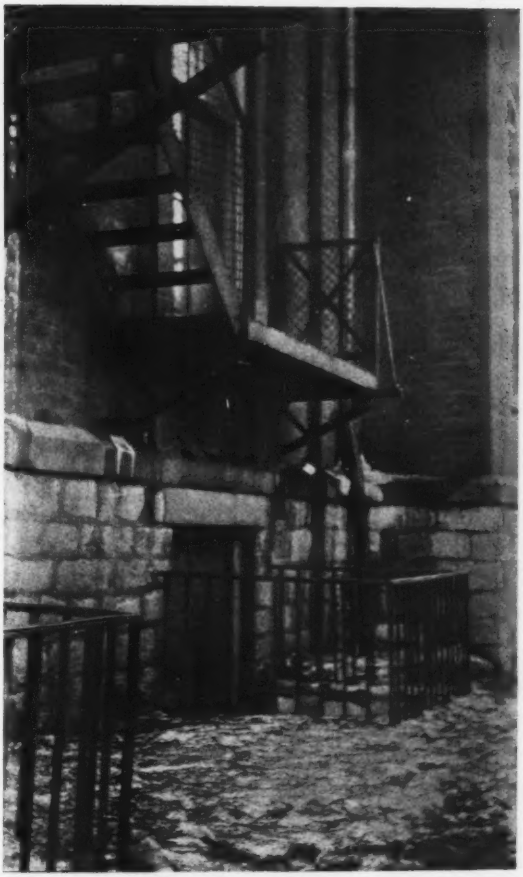
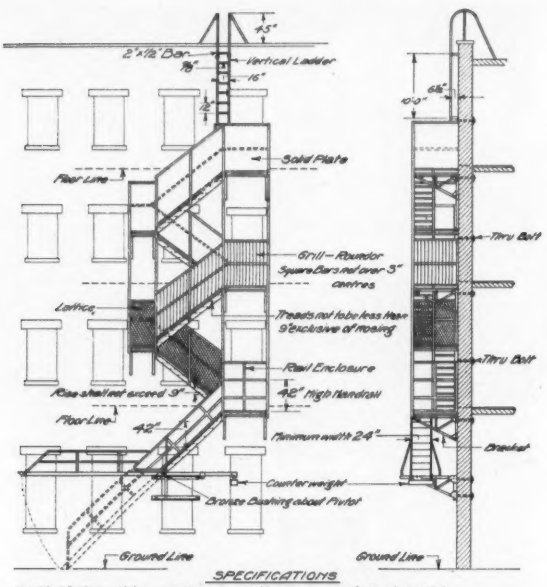


Fig. 20. A typical trap installed in the name of safety, *ending over areaway*. Moreover, window exits are obstructed by flower boxes and unprotected windows expose fire escape.

old buildings it is occasionally advantageous to install such partitions. Sometimes existing walls can be improved to serve this purpose. Where buildings are thus sub-divided the first concern at time of fire should be to get the children through the partition out of the section in which the fire is located and into the section which is safe.

Signs and Lighting.

Red and white exit signs, with letters at least 5 inches high and illuminated at night, should be placed over all stairways and doors


45°
2"x1/2" Bar
Vertical Ladder
16"
Solid Plate
Floor Line
Thru Bolt
Grill – Roundor Square Bars rod over 3" centres
Lattice
Treads not to be less than 9" exclusive of nosing
Rail Enclosure
42" High Handrail
Rise shall not exceed 9"
Floor Line
42"
Minimum width 24"
Bracket
Counter weight
Brace Bushing about Pivot
Ground Line
Ground Line
SPECIFICATIONS
Height of Building – Not recommended on buildings over six stories in height.
Location – Stairs should preferably be against blank wall; access from all openings to stairs being by horizontal balconies. Wall openings within 10' of such stairs to be protected by approved automatic fire doors or shutters and automatic or fixed fire windows or window openings.
Doors – Shall have minimum width of 30" and minimum clear height of 78".
Balcony and Stair Enclosures – Shall be of at least 50" between railings or superimposed form and at least 36" in straight run stairs.
Stairs – Minimum clear unobstructed width shall be 24". The pitch of stationary and of swinging stair (when down) shall not exceed 45°

Courtesy Crosby-Fiske-Forster Handbook of Fire Protection.

Fig. 21. Standard outside stairs (as recommended by N. F. P. A.).

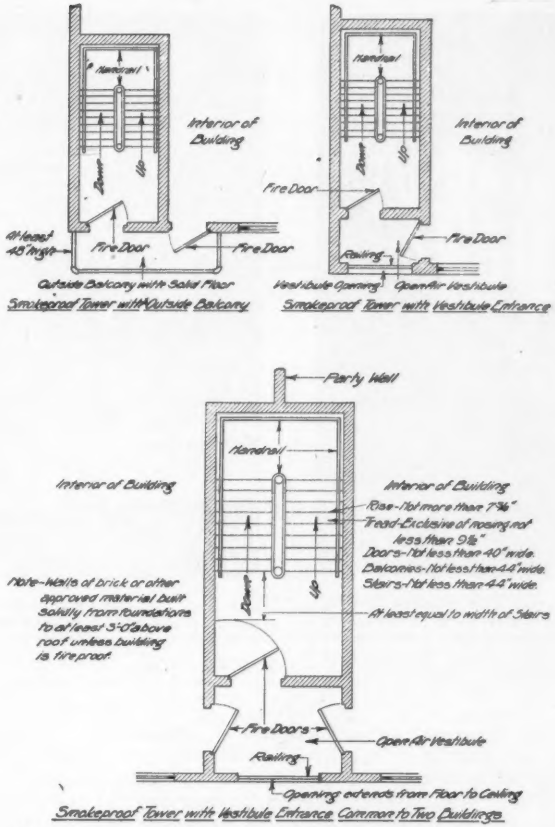
leading directly to the outside. Exit signs should not be omitted over doors leading from roofs and basements. Secondary egress signs for classrooms, auditoriums, laboratories, etc., may be advisable in large schools.

In order to simplify instructions, all stairways and outside exit doors can be numbered and these numbers used for drill and other purposes.

The current for exit lights should preferably be obtained from a system separate from that ordinarily used for lighting purposes. It is also well to provide auxiliary gas lights for use in case the electric service is interrupted.

Fire Drills.

With the present generally poor structural conditions and lack of fire extinguishing facilities the need for fire drills is evident, and in most states monthly fire drills are required by law or by school regulations.



Courtesy Crosby-Fiske-Forster Handbook of Fire Protection.

Fig. 22. Smokeproof Towers.

The purpose of a fire drill is to get all persons out of the building every time that the alarm is sounded, at any hour, under any conditions, in as short a space of time as possible. Such a result cannot be secured by any half-hearted compliance with the law or the rules.

It should be remembered that although on one day 600 children marched out of the Peabody School in one and one-half minutes during a fire drill, on the next day 21 of these very children lost their lives in that building because of the poor construction and lack of proper control and variation during fire drills. Nor does the regular fire drill of pupils lessen the hazard when schools are used for public gatherings. On all such occasions, as soon as the audience is seated, its attention should be called to the location of exits, the manner in which these should be

Fig. 23. Imagine little children piled up against these gates with the building afire and falling upon them. Even when padlock is removed, hasp may catch on staple and hold gates closed.

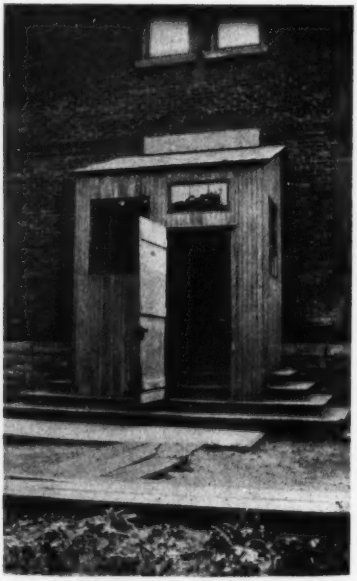


Fig. 24. Exit badly obstructed by storm door. A jam and panic such as happened at Collinwood might easily occur here.

reached, and the need for self-control if fire occurs. During larger gatherings of this sort uniformed policemen or firemen should be stationed in the hall to take charge in event of emergency.

New York State requires a monthly fire drill in every school over one story in height which houses one hundred or more pupils. Failure on the part of principals to hold such drills is punishable by a fine of not over $50. In Indiana teachers must present each month a certificate stating that fire drill has been held as required before they receive their salary. Other states have enacted similar legislation. The provisions, however, generally do not apply to colleges and universities.

Organization.

The organization for the conduct of fire drills in schools should coincide with the organization which handles the daily routine of the school. Where two schools occupy the same building one of the principals should take charge and the other should act as assistant. The older and more reliable children should be selected to lead the line of march. Where pupils must perform special duties, such as opening doors, playing music, etc., their movements should be carefully planned so that they will carry out their duties without confusion or special instruction.

Execution.

All fire drills should originate with the principal unless the school is equipped with a thermostatic or automatic sprinkler alarm system. After the first one or two drills, all drills should be unannounced and should be in the form of tests.

Wherever possible, march time music should be played throughout the drill. As the building is emptied, janitors and others appointed for this duty should see that no pupils are left behind. Teachers should ordinarily stand at the doorway to be used until their pupils have passed out, and should then follow at the rear of their line. This type of drill is applicable to all schools, public and private, from primary schools to colleges. The same orders and methods of control that are used in conducting fire drills should be used for daily dismissals at recess and close of school.

Calling the Roll.

As soon as a teacher has marshalled her class out of the building and to its designated place at a safe distance, she should see that the roll of her class is called at once and as rapidly as possible. The teacher should keep her attendance record up to date and should procure this the moment the fire alarm sounds. The value of the roll call was clearly demonstrated at the Wellesley College fire, when it showed eight girls missing after it was thought that all were out of the burning building. These eight girls were found asleep and were rescued. Except for the prompt roll call they would probably have perished. In dormitories the roll should be carefully kept by the proctor or other person in charge of the building.

Boards of education and the management of private schools should require principals to render regular reports of fire drills held in their schools, including time of drill, weather conditions, number of pupils and time taken for egress.

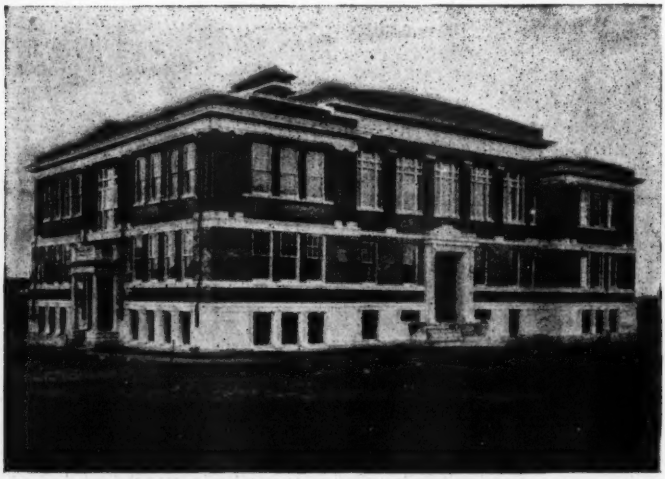
Spread of Fire.

The almost lightning-like speed with which many fires spread is generally due to a combination of combustible construction, large unbroken areas, open stairways, and various floor openings. Many of the older wooden interior schools, with central open wooden stairs, and frequently without even the basement stairway cut off, are ideally designed for a quick-spreading fire that would cut off escape of the occupants. The studding, furthermore, is often unstopped from the basement to the attic, and a few minutes after a basement fire got under way the attic would be a mass of flames and the building doomed.

In contrast to such a school is the modern fire-resistive structure in which the amount of combustible material is reduced to a minimum, the fire areas are moderate, each room is capable of confining within its limits a fire of considerable intensity, egress stairs and other shafts are enclosed and there are two ways out from each important point.

New Buildings.

There is no excuse for anything but the best construction for new schools. The difference in cost between the best construction and



Courtesy American Concrete-Steel Co.

Fig. 25. Brick and wood-joisted school building Same plan and cost as building shown in Fig. 26. Interior construction of wood, wooden cornices, and ceilings of stamped metal.

distinctly dangerous construction is never enough to warrant exposing our children. (See Figures 25 and 26.) Occasionally the better building is the cheaper. The literature of the National Board of Fire Underwriters, the National Fire Protection Association and the National Education Association is particularly valuable to the architect called upon to design a new school.

One-story schools need not be of fire-resistive construction to secure adequate life safety if they have individual room exits. (See Figure 16.)

Two-story schools seldom need be of fire-resistive construction if areas are moderate and if adequately protected exits are provided.

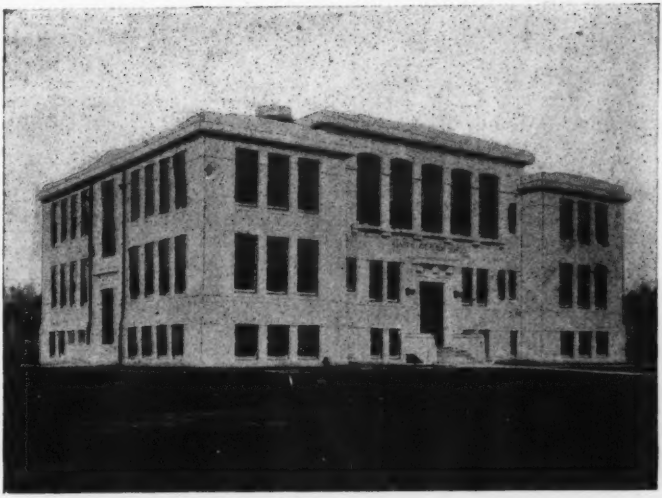
Three-story and higher schools should be fire-resistive in the best sense of the word, with stairs and other vertical openings protected.

It is particularly important that where additions are built to existing buildings the new construction be modern from a fire standpoint and not a duplicate of the old, and that there be a definite fire cut-off between these two sections.

Existing Buildings.

Obviously our fire dangers lie chiefly in our older schools two stories or more in height. Improving them as regards the restriction of fire spread is often desirable and occasionally undertaken. The installation of sprinkler equipment may in some cases be cheaper than structural changes and yet provide the same improvement in life safety.

It is a common fallacy to assume that because a building has brick or stone walls it is relatively safe. From a life safety standpoint there



Courtesy American Concrete-Steel Co.

Fig. 26. Reinforced concrete school building. Nothing to burn in construction; maintenance costs at a minimum; depreciation negligible.

is little to choose between a building that has incombustible walls and one which has wooden walls. The danger lies in wooden interior construction, permitting the fire to spread upward through stair and other openings, to run through open studding, and sometimes in the relatively early stages of fire even to burn through the floor. (See Figure 27.)

Improvements of the kind that are certain to need consideration in any city of size and in connection with groups of college buildings include the following:

Cutting Off Stairs.

The basement fire is the most dangerous, and the first steps should be to cut off the basement stairs effectively and to stop off equally well all other openings which might let fire spread from the basement upward. For buildings of ordinary construction expanded metal nailed on both sides of wood studs and covered with hard plaster makes an effective enclosure. Doors are desirable both at the top and bottom of basement stairs. The loss of life in the Peabody School has been attributed to the curiosity of a child who opened a door leading from the basement stairs to the first story, and admitted fire into the hall where children were crowded. (See Figure 28.)

For most buildings of two stories or higher it is desirable that other stairs also be enclosed. Expanded metal and plaster partitions or metal and wired glass are satisfactory for this purpose. The doors leading to stairs should normally be kept closed and should not be too heavy.

Courtesy Safety Engineering.

Fig. 27. Schoolhouse built to burn. Building contained 32 rooms. 900 children escaped because of excellent fire drill. Loss $200,000.

Other Vertical Openings.

Any other form of floor opening should be eliminated or enclosed as may be most practicable. Light wells are particularly objectionable. Elevator shafts and dumb waiters should be treated in the same way as stair shafts. The spaces between the studding should be cut off with cement, mineral wool, timber, or a combination of these, particularly at the basement ceiling and also preferably at the attic line.

Division Walls.

Sometimes in large buildings it is possible to make fairly effective fire walls of existing walls. Unnecessary openings can be bricked up, walls can be carried through the attic and the roof, timbers which originally passed through the walls can be cut off so as not to create a continuous combustible channel through the wall, and necessary fire doors can be provided. Generally speaking, if improvements of this kind are undertaken it is well to do the work in such a way that it will

Courtesy General Fire Extinguisher Co.

Fig. 28. Peabody school after fire. Shows hallway where 21 girls were burned to death, a successful fire drill the day before notwithstanding.

have distinct property saving value, and not merely give somewhat greater life protection.

In some combustible schools of large area the only proper treatment is to build one or more effective fire partitions across the building. Some of the large public and private school buildings in the country are hundreds of feet long, the equivalent of five or six floor levels in height, and literally without any semblance of a fire stop either horizontally or vertically. Such conditions in a factory or mercantile block would be considered little short of an economic crime, and it certainly is quite as desirable that the same steps which would be taken in a business building be taken in a building housing hundreds of children, many of them young and some physically handicapped.

Fireproofing Dangerous Sections.

Not infrequently it has been found advisable in school buildings of combustible construction to make the boiler room strictly incombustible and to build effective fire-resistive oil rooms or vaults. Such special hazards properly belong outside of the structure, but if they must be inside of the building by virtue of the geographic conditions, then incombustible construction is often the answer.

Exposure.

The biggest factor in preventing exposure fires from affecting school buildings is to eliminate shingle or other combustible roofing. Shingle roofs are objectionable also because sparks or brands from the chimneys of the school itself may set fire to the roof. No existing shingle roofs should be permitted to be repaired extensively with wood

shingles. Various approved forms of fire-resistant roofing materials weighing about the same as wood shingles may be installed without appreciable difference in cost.

Occasionally where school buildings of importance are close to combustible exposing structures it is desirable to do away with overhanging wood roofs by carrying the walls up above the roofs in the form of parapets and by providing metal frames and wired glass for windows and fire doors for door openings.

Wired glass in metal frames is used extensively to protect persons who may use a fire escape against fire within the building.

Legislation, Inspection, and Education.

Legislation.

Some good legislation has been enacted in a number of states during the past few years for furthering fire protection for schoolhouses. The best of this legislation, however, has been directed almost entirely toward the improvement of exit facilities and toward securing better construction in new buildings. For this reason it has had very little effect upon reducing the monetary fire loss, as it has been aimed neither at the causes of fire nor toward providing better fire extinguishing facilities.

A great weakness in present legislation lies in the all too frequent use of such indefinite terms as "sufficient," "proper," "ample," "necessary" and "suitable." This commonly places the responsibility for interpretation upon untrained persons, and among these there is much disagreement as to proper procedure. Even where there is fairly specific legislation it is seldom thoroughly enforced. In the face of the opposition and differences of opinion encountered, it is exceedingly difficult for fire marshals, fire chiefs, or any others interested in the matter to secure proper enforcement of the laws.

Most of this legislation has been enacted as the direct result of some especially severe fire loss, and the features covered have generally been only those which were most forcibly brought out in that particular fire. With the exception of a very few states, there has been little done in the way of systematic study of the fire protection problem in schools and colleges. What little has been done shows the great inadequacy of state legislation as it now stands. New York City found it necessary to enforce eight separate regulations to cover the main points of protection in the public schools of the city. The majority of state laws make no reference to fire protection in colleges and universities.

New Construction.

One important need is for the establishment of standards of new building construction. This can be most easily and satisfactorily met by adopting the recommendations embodied in the building code of the National Board of Fire Underwriters, copies of which can be secured from that organization. Standards must also be established for such matters as housekeeping, safeguarding of special hazards, egress facilities, fire drills and extinguishing equipment. The data available through the National Board of Fire Underwriters and the National Fire Protection Association will fill practically every legislative need.

Inspection.

To be effective, existing laws and regulations must be interpreted and applied by capable fire prevention engineers, and this should be the work of the state fire marshals and city inspectors. It is obvious that a sufficient number of adequately trained men is the only answer.

Inspections by outside agencies, which should be made preferably twice a year, should be supplemented by frequent inspections by one or more of the following:

(*a*) Members of the public fire department.
(*b*) Instructors.
(*c*) Janitors.
(*d*) Pupils.

Where night watchmen are employed, they should be properly instructed in all matters of fire protection and should be examined frequently as to their knowledge. The degree of ignorance of the ordinary watchman concerning matters of fire protection is colossal.

Education.

The education of the public in matters of fire prevention is the most important step that can be taken toward limiting the loss of life and property by fire. Members of the National Fire Protection Association, as individuals and as organizations, have worked hard and faithfully to reach the public through printed word and personal contact, and their efforts are now beginning to bear fruit. Fire prevention bureaus are being formed, better building codes are being adopted, inspection service is improving, chambers of commerce in various cities are showing an interest in fire protection, and various other organizations and clubs have helped the cause along.

Courses in Schools.

If within the next year the teaching of fire prevention were incorporated in the courses of all schools and colleges in the United States it is safe to predict that the effect upon the fire waste would be very great. Matters of fire prevention and fire protection are so closely connected with matters of chemistry, physics, sanitary engineering, and other established branches of study that emphasis can be laid upon them in connection with these studies to excellent advantage. Some states already require that a certain amount of time be devoted each month to the study of fire prevention in grammar schools. This should be required in the upper grades of all grammar schools to the extent of at least two hours a week. The National Board of Fire Underwriters has issued an excellent booklet entitled "Safeguarding the Home Against Fire," which is already being used in many schools and is available at nominal cost.

In high schools and colleges, "Safety for the Household," which is circular No. 75 of the Bureau of Standards, can be used to advantage. It can be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C. This book treats very thoroughly the common accident and fire hazards that are to be found in homes.

For scientific courses in high and preparatory schools, and especially

for engineering courses in technical schools and universities, the use of one or more of the available fire protection books is advisable.

In all cases the study of text-books should be supplemented by the reading of current fire protection literature and by the study of recent fires. All pupils should at some stage in the course be taken to a public fire department station, and the operation of the apparatus, fire alarm system and the organization of the department should be thoroughly explained to them.

Inspection by Pupils.

Children should also be required to make thorough inspections of the school buildings, their homes, and possibly churches, libraries, and other public buildings where such inspections can be made.

A part of the duty of a school fire brigade is to make regular periodic inspections of fire hazards, fire-fighting equipment, and egress facilities, and to test apparatus and appliances. Reports of these inspections should be submitted to the principal upon a regular inspection blank.

For educational purposes a daily inspection of this type is a great advantage, as it serves not only to maintain good conditions, but by rotating the inspection work brings to bear the point of view of many persons and gives these persons very definite education.

It should be remembered that the degree of attention given to fire protection in the school buildings themselves will to a large extent determine the importance of fire protection in the estimation of the child. The best literature on fire protection should be available in every school library, and important matters should be emphasized by pictures and mottoes.

Knowledge is the basis of all intelligent action, and where proper protection is afforded the knowledge of the children as to the value of fire doors, fire walls, automatic sprinklers, and a properly executed fire drill will do much toward preventing panic.

Conclusion.

What the country needs is national team work in fighting the fire waste. Our schools have a double responsibility and opportunity in the premises: first, to put their own houses in order, and second, to wield a powerful educational influence.

Impairment of Automatic Sprinkler Protection in Refrigerator Rooms.

By Canadian Fire Underwriters' Association, Montreal.
(Member N. F. P. A.)

In January and February last a large amount of ice was found by Inspectors C. W. Ellsworth and T. H. MacPeak in a detailed examination of the sprinkler piping in the refrigerator rooms of a large packing house, equipped mainly in 1908, although it might be noted that no ice was found in the refrigerator rooms in a new section placed under automatic sprinkler protection in September, 1918. The condition of the fire appliances as a whole, however, was not considered satisfactory, and the benefit of the doubt was therefore given and the impairment of the protection in the refrigerator rooms charged solely to poor maintenance.

The greater part of the month between May 2nd and June 4th, 1919, was taken by Inspector C. F. Harris in a detailed examination of the sprinkler system in the refrigerator rooms of an entirely different property under separate management, and the protection was found impaired as set forth below. The investigation originated through the short time necessary to restore the normal air pressure on the middle section of the sprinkler equipment in the cold storage building, the object of the inspector's visit having been to test out the mechanical types of dry-pipe valves by "gravity trip," with the controlling gate valves shut. This Association rendered an elaborate report in 1915 on the conditions found with the equipment in the same property by Inspectors D. C. Winsor and E. R. Wilcox, which disclosed 117 sprinklers out of a total of 571 in various refrigerator rooms entirely out of service, or approximately 20 per cent. of the equipment for those sections, with 10 other sprinklers partially out of service.

In the cold storage building referred to the sprinkler equipment is divided into three sections, known respectively as east, middle and west, with a separate dry-pipe valve for each. The temperatures of the rooms vary from 20 degrees F. below zero to 40 degrees F. above zero, and the sprinkler risers pass through rooms of different temperatures. The systems require frequent pumping, the loss of air pressure averaging about 10 lbs. daily for each section. The system was installed in 1913, since when there have been changes in temperature of rooms owing to different storage.

In the cold storage rooms of the main plant the sprinkler system was installed in 1905 without reference to the temperatures of the different rooms, which vary from 15 degrees F. below zero to 40 degrees F. above, and there have been a number of changes in the locations of the sharp freezers and coolers since. Average daily loss of air pressure, 4 to 12 pounds.

History of Maintenance of Sprinkler Protection Since Report of May, 1915.*

Cold Storage Building, East Section.

Times Flooded:

December, 1915. The dry-pipe valve tripped during the night some days prior to December 28th, 1915, and system drained and pipes examined by management. Those in freezer No. 7, first story, were found blocked with ice. This room was the only one in this section below frost at the time. The pipes were examined on December 28th, 1915, by Inspector D. C. Winsor and none found frozen, but water was found in rooms above freezing where a low point had not been properly drained. Local alarm failed to operate when dry-pipe valve tripped.

March 3rd, 1916. The system was found flooded on the 7 p.m. round of the watchman, although it was in order on the 4 p.m. round. The system was immediately drained by the watchman, but several days were required to thaw out the frozen piping and restore the protection. Local alarm failed to operate when dry-pipe valve tripped.

Times System Shut Off and Air Drained for Purpose of Changes, Repairs or Examinations; No Flooding:

July 3rd, 1915, February 9th, 1916, March 6th and 24th, 1916, August 31st, 1916, October 19th and 20th, 1916, October 30th, 1916, November 29th, 1917, February 6th, 1918, April 2nd, 1918, June 14th, 1918, November 5th, 1918, May 2nd, 1919 (to trip the dry-pipe valve).

On September 8th and 15th, 1915, some piping was examined in the presence of Dr. H. T. Barnes of McGill University, Inspector D. C. Winsor, and other representatives of this Association, those pipes found badly frozen in May, 1915, being particularly examined.

On August 16th-31st, 1916, considerable of the sprinkler piping was examined by Inspector A. L. Mitton, and a special report made. A small amount of ice was found, but systems generally were reported in good shape. This examination was not as detailed as that of May, 1915.

Middle Section.

Times Flooded:

Some time prior to September 8th and 15th, 1915, when some of the piping was examined in the presence of Dr. Barnes and others, as noted under East Section, a small amount of ice was found in the Middle Section on above dates.

Times System Shut off and Air Drained, for Purpose of Changes, Repairs or Examinations; No Flooding:

October 20th, 1915, March 27th, 1916, August 31st, 1916, October 19th-20th, 1916, November 29th, 1916, April 30th and May 1st, 1917, June 15th-18th, 1917, April 2nd, 1918, June 14th, 1918, July 17th-22nd, 1918, November 4th and 5th, 1918, May 2nd, 1919 (to trip dry-pipe valve).

*Note: It is the rule of this firm to notify the Underwriters by telephone and letter, of any interruption to the automatic sprinkler system. While this has been overlooked on occasions, the dates mentioned have been compiled on these notifications, the red tags on sprinkler valves, and other data on file.

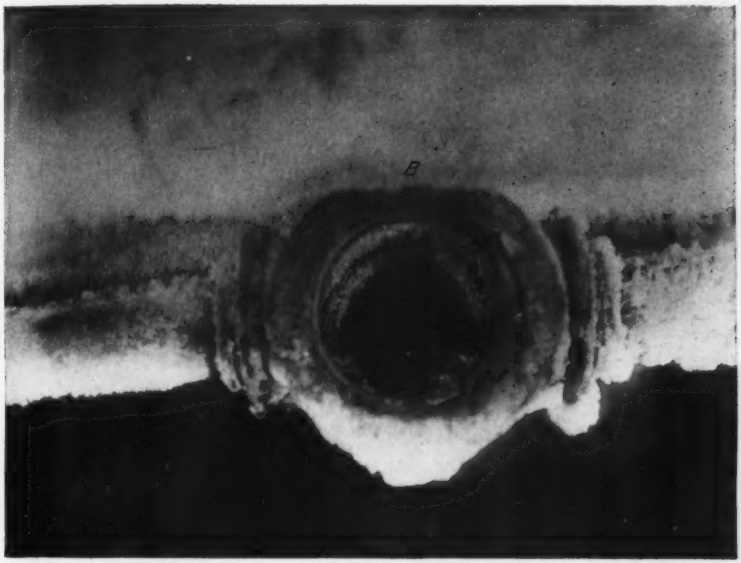


Fig. 1. Sprinkler piping in basement of Middle Section, Cold Storage Building. **(See page 68).**

On August 16th-31st, 1916, system gone over by Inspector A. L. Mitton, as noted under East Section.

West Section.

Times Flooded:

March 25th, 1916, at 2 a.m. dry-pipe valve tripped after minor alterations had been made to system. The local sprinkler alarm in the engine room operated and system said to be promptly drained and restored. Later the piping was examined and found frozen in Freezer No. 7, first floor. Not known to what the loss of air could be attributed, but a theory is the melting of an ice plug in Freezer No. 4, second floor, where the temperature had been raised to above frost, due to change in character of storage. Small sprinkler lines were found frozen solid and the cross mains about one-half blocked. Piping in other stories also examined, but clear, except at one low point which had been overlooked. A special report was made by Inspector E. R. Wilcox on that date.

February 28th, 1919, 1.55 a.m. fire in beef cutting room operated system, which was under water for about five minutes. Afterwards tests were made on the various floors by removing end sprinklers on several lines with controlling gate shut and air pressure of 30 pounds. Result indicated system was apparently free from serious obstruction except a low point exposed to the weather which had not been drained. Repairs were made and system restored to service.

Times System Shut off and Air Drained, for Purpose of Changes, Repairs or Examinations; No Flooding:

October 20th, 1915, March 3rd and 6th, 1916, August 31st, 1916, October 24th-25th, 1916, November 28th, 1916, May 29th, 1917, April 2nd, 1918, June 14th, 1918, November 4th and 5th, 1918, May 2nd, 1919 (to trip dry-pipe valve).

On September 8th and 15th, 1915, examination of some of piping by Dr. Barnes of McGill University and others, as noted under East Section.

On August 16th-31st, 1916, examination of system by Inspector A. L. Mitton, as noted under East Section.

Cold Storage Rooms of Main Plant.

Times Flooded:

None on record.

Times System Shut off and Air Drained, for Purpose of Changes, Repairs or Examinations; No Flooding:

July 5th, 1915, October 19th-20th, 1915, January 6th, 1916, April 17th, 1916, May 8th, 1916, May 10th, 1916, May 15th, 1916, June 16th, 1916, August 31st, 1916, December 13th, 1916, February 16th, 17th, 18th and 19th, 1917, March 26th, 1917, May 5th, 1917, September 27th, 1917, October 2nd and 27th, 1917, June 13th, 1918, July 3rd, 1918, July 31st, 1918, November 4th and 5th, 1918, December 23rd, 1918, March 7th, 1919, April 30th, 1919, and May 1st, 1919 (to trip dry-pipe valves).

On August 31st, 1916, a portion of piping and sprinklers removed by Inspector A. L. Mitton; system reported in order.

Percentage of Sprinkler Equipment Found Out of Service, May—June, 1919.

Cold Storage Building.

Floor.	Occupancy.	Total No. of Sprinklers.			No. of Sprinklers Out of Service.		
		East.	Middle.	West.	East.	Middle.	West.
Basement.	Meat freezer 13°F. ..	32	33	32	..	33	..
1st.	Eggs, butter, fresh meat, 33°F. 40°F... Beef hanging 40°F.	32	34	32	32p	34	..
2nd.	Meat freezers, 20°F. below ..... Beef hanging 40°F.	32	34	32	32p	34	32p
3rd.	Meat freezers, zero..	36	39	36	36p	39	36p
Mezzanine.	45-50°F. above	51	..	..	51p	..	..
		183	140	132	151p	140	68p

("p" means partially out of service.)

Total number of sprinklers involved 455
Total number entirely out of service 140
Total number partially out of service..... 219

31% of total equipment entirely out of service.

48% of total equipment partially out of service due to formation of ice in supply riser piping.

79% of total equipment affected.

Note.—Only sprinklers in cold storage rooms are included in this table.

Fig. 2. Sprinkler piping in basement of Middle Section, Cold Storage Building. **(See page 68).**

Cold Storage Rooms in Main Plant.

Floor.	Occupancy.	No. of Sprinklers.	No. of Sprinklers Affected.
Basement.	Pickle Cellar. Temp. 32°F. to 40°F.	84	None.
1st.	Freezer No. 3. Temp. 10°F. below to 15° F. above zero	36	36 partially out of service.
	Freezer No. 4. Temp. 10°F. below to 15° F. above zero	20	None.
2nd.	Freezer No. 5. Temp. 10°F. below to 15° F. above zero	38	38 practically out of service.
	Freezer No. 6. Temp. 10°F. below to 15° F. above zero	38	38 practically out of service.
		216	112

Total number of sprinklers involved 216
Total number of sprinklers partially out of service.. 36
Total number of sprinklers practically out of service 76

17% of total number of sprinklers involved partially out of service.
35% of total number of sprinklers involved practically out of service.
52% of total number of sprinklers involved were affected.

Note.—Only sprinklers in rooms with temperatures below freezing are included.

Fig. 3. Basement, Middle Section, Cold Storage Building. **(See page 69).**

Explanation of Illustrations and Detail of Ice Formations.

Cold Storage Building, East Section.

Basement.—Meat freezer, 13 degrees F. above zero. First story, Fresh Meat, 33 degrees to 40 degrees F. above zero. Second story, Beef Hanging, 40 degrees F. above zero. Mezzanine, 45-50 degrees above zero.

Formation of solid ice found in riser at first story level. The obstruction was dislodged from position when hammering to break the elbow at the base of the riser. (See Fig. 7.) Quantity of ice removed would indicate that riser was almost completely blocked. There was a small deposit of frost in cross main in basement where directly in contact with refrigerator piping, and considerable in 3½-inch main supply pipe about 10 feet from the dry-pipe valve and 4 feet inside basement.

The temperatures of all floors above the basement are above freezing and it was not considered necessary to examine the piping above the first floor level.

Middle Section.

Basement.—Meat freezer, 13 degrees F. above zero. The refrigeration coils on the ceiling and wall were partly in contact with sprinkler piping. There was a heavy formation of frost on refrigeration coils on

Fig. 4. First Floor, Middle Section, Cold Storage Building. (See page 69).

ceiling and small formation of frost on sprinkler piping where located close to same. Refrigeration coils on sides were not in service. One piece of 3½-inch pipe, acting as cross main to sprinklers in basement and main supply to sprinklers on the floors above, and partly enclosed in cork insulation of the building, was found completely blocked with formation of part solid and part snowy ice where pipe was in contact

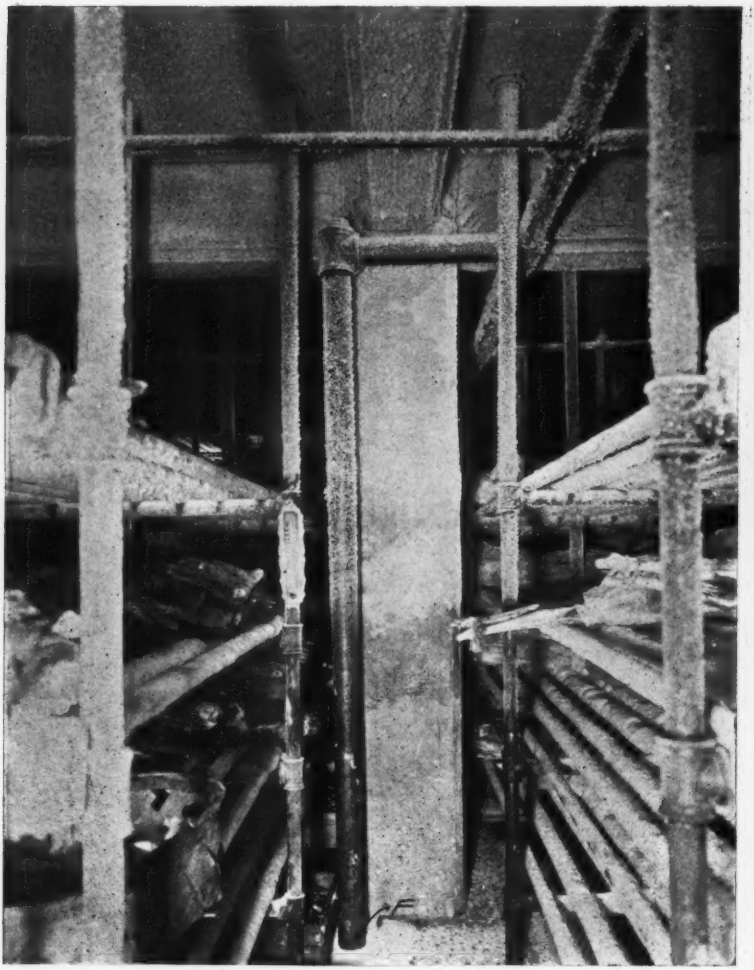


Fig. 5. Second floor, Middle Section, Cold Storage Building. (See page 69).

with insulation. This was more or less porous and admitted air to the sprinkler piping in basement, as was proved by removing sprinklers under air pressure before attempting to break open system. (See "B," Fig. 1, and "A," Fig. 2.)

The 3½-inch, 2½-inch and 1½-inch pipes on cross mains, where in contact with refrigeration coils, were partly obstructed by formation of snowy ice and frost. Branch lines and cross main piping not affected

Fig. 6. Basement, Middle Section, Cold Storage Building. (See below).

where not in contact with refrigeration coils. (See "B," "C" and "D," Fig. 3, and "G," Fig. 6.)

First Floor.—Egg Storage, 33 degrees to 35 degrees F. above zero. The 3½-inch riser from basement was completely blocked with solid ice from first floor level upward for two feet. Ice in clear condition and removed in solid form by heating outside of riser with blow torch. (See "CC," Fig. 4, and "HH," Fig. 6. Water melted from ice would equal about one gallon. This cut off all sprinklers above basement on this section. There was a double cut off for heads on second and third floors, as noted below.

Second Floor.—Meat freezer, 2 degrees F. above zero. The 3½-inch riser, first to second story, was found completely blocked with solid ice from the ceiling of the first story (temperature 32 degrees to 35 degrees F. above zero), and extending 4 inches above the floor level, total length of ice 20 inches. Piping was not in contact with refrigeration coils on this floor. There was a slight formation of frost in a part of the cross main. (See "E," Fig. 4, and "F," Fig. 5.)

Third Floor.—Meat freezer, zero to 2 degrees F. above zero. In the 3½-inch riser from second floor there was a formation of ¼-inch frost for a distance of 8 feet above floor level; none in the elbow at the base of the riser. No other formation of frost or ice noted. (*Note.*—Elbow at base of riser was found frozen solid at examination of May 3rd-13th, 1915.)

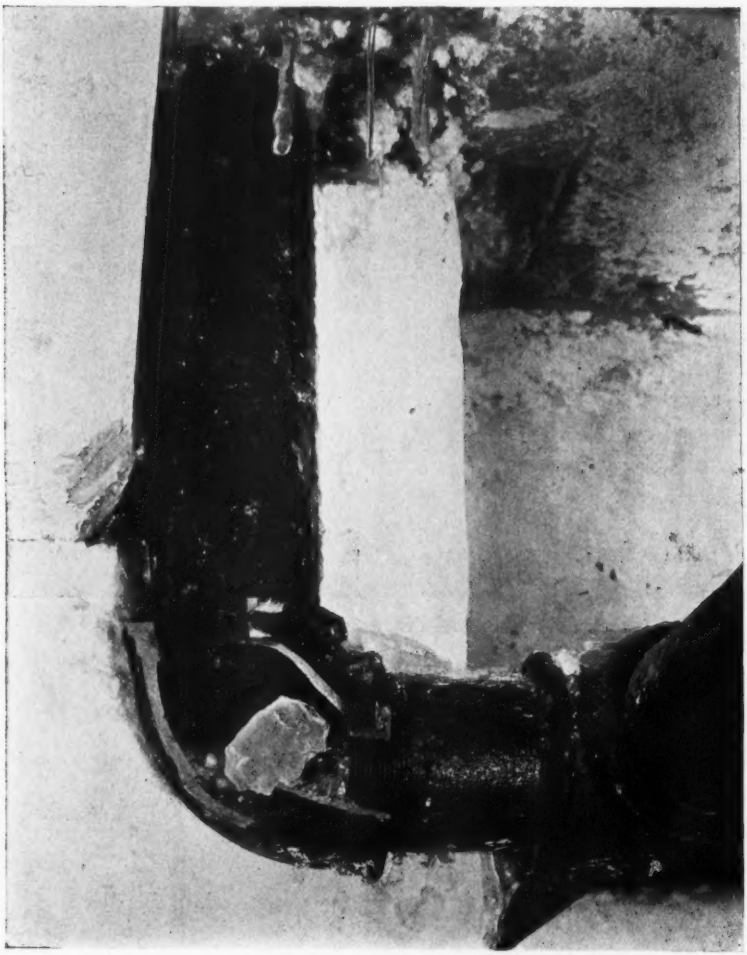


Fig. 7. Riser in East Section, Cold Storage Building. (See page 66).

West Section.

Basement.—Meat Freezer, 13 degrees F. above zero. First floor, Butter Room, 33 degrees F. above zero. Second floor, Meat Freezer, 2 degrees F. below to 13 degrees F. above. Third floor, Meat Freezer, 2 degrees F. above zero. The 3½-inch riser on the second floor was partly blocked with solid ice for a length of six inches, reducing the size of outlet from 3½ inches to 2½ inches. The cross main, which is also

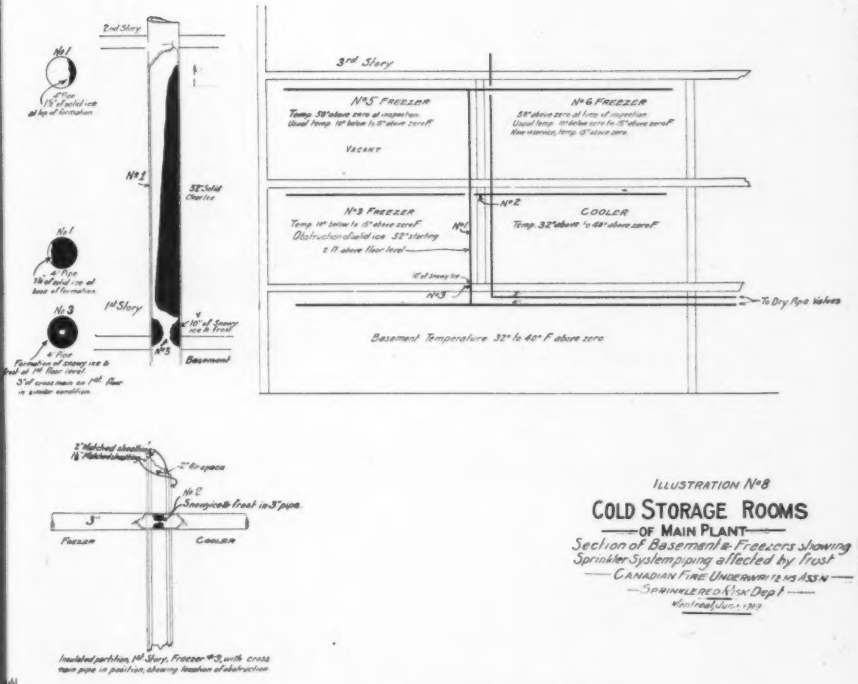

2nd Story
No 1
4" Pipe
1/8" of solid ice at top of formation
No 2
3/4" Solid Ice
No 1
4" Pipe
3/8" of solid ice at base of formation
1st Story
No 3
4" Pipe
Formation of snowy ice & frost at 1st floor level
3rd cross main on 1st floor in similar condition
4" 10" of Snowy ice & frost
No 3
Basement
3rd Story
No 5 FREEZER
Temp. 58° above zero at inspection
Usual temp. 10° below to 8° above zero F.
VACANT
No 6 FREEZER
58° above zero at time of inspection
Usual temp. 10° below zero to 15° above zero F.
Now stacked, temp. 15° above zero.
No 3 FREEZER
Temp. 10° below to 15° above zero F.
Obstruction of solid ice 32" starting
2 ft above floor level
No 1
No 2
COOLER
Temp. 32° about 1 to 40° above zero F.
12" of Snowy Ice
No 3
To Dry Pipe Valves
Basement Temperature 32° to 40° F above zero
2" Hatched sheathing
2" Air space
No 2
Snow ice & frost in 3" pipe
3"
Freezer
Cooler
Insulated partition, 1st Story, Freezer No 3, with cross main pipe in position, showing location of obstruction

ILLUSTRATION No 8

COLD STORAGE ROOMS

OF MAIN PLANT

Section of Basement & Freezers showing Sprinkler System piping affected by frost

CANADIAN FIRE UNDERWRITERS ASS'N

SPRINKLERED RISK Dep't

Montreal Jan. 1919

Fig. 8. Cold Storage Rooms of Main Plant.

the supply main to the sprinklers in third story, had a deposit of solid ice in the lower portion. Ice was ¾-inch to 1-inch thick and extended practically the full length of the cross main west of the riser. Remaining half of cross main had a slight deposit of frost where in contact with refrigeration coils. (*Note.*—This section of piping was under water on February 28th, 1919, when the system operated due to a fire in the Beef Cutting Room.)

Cold Storage Rooms of Main Plant.

Basement.—Temperature 32 degrees F. to 40 degrees F. above zero.

First Story.—Temperature 10 degrees F. to 15 degrees F. above zero.

Second Story.—Temperature 10 degrees F. to 15 degrees F. above zero.

Freezers Nos. 5 and 6, which are located in the second story, were emptied of stock on May 20th, 1919, and the temperature of the room was raised from 15 degrees F. to 58 degrees F. above zero.

First test was made by loosening several sprinkler heads while

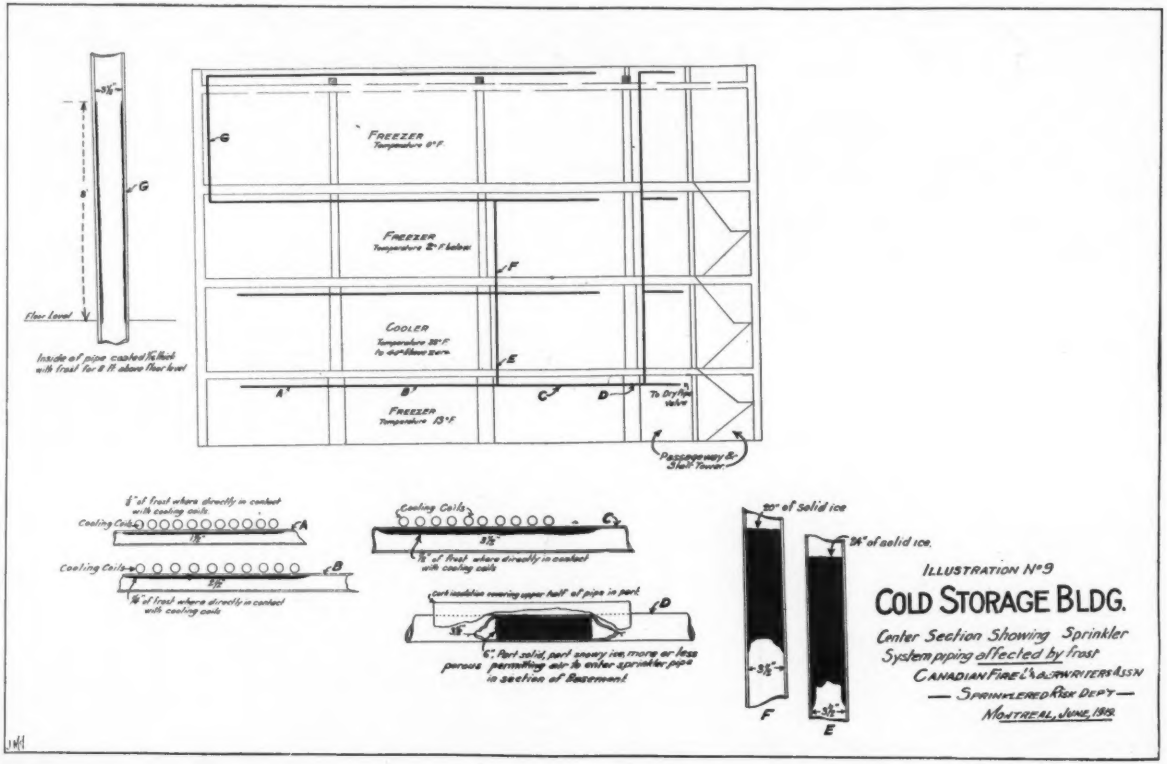


Fig. 9. Cold Storage Building.

system was under 40 pounds air pressure, and results indicated that the system was in service.

The 4-inch elbow at the base of the supply riser was then broken with a hammer and a considerable quantity of loose frost removed. A serious obstruction was noted at the first floor level, which proved to be a formation of snowy ice, for a distance of 10 inches above the floor level. Another obstruction was found 1 foot 6 inches above the first, which proved to be solid clear ice, almost completely blocking the area of the riser. The obstruction was removed by heating the outside of the riser with a blow torch, and the total length of ice removed measured 52 inches, and varied in thickness from 3½ inches at the base to 1½ inches at the top; the amount of water derived from the ice and frost when melted was 1½ gallons. (See Fig. 8.)

This system, which is known as "G" line, is in part located in the basement and the second story, with the main supply riser piped through freezers Nos. 3 and 4 in the first story, where the temperatures range from 10 degrees F. below zero to 15 degrees F. above zero, and it was stated by the management that the existing temperatures have been maintained without interruption for over two years.

Loss of air in system, 4 pounds per 24 hours, and loss is replaced daily.

Examination of piping in freezers Nos. 3 and 4, first story, showed a serious obstruction by snowy ice and frost in the portion of cross main where in insulated partition.

This system is known as "D" line, with only a small portion of the piping subject to freezing temperatures, being that located in freezers Nos. 3 and 4 and riser in freezer No. 6.

The 5-inch supply riser is located in rooms where temperatures range from 32 degrees F. to 40 degrees F. above zero. Nos. 3 and 4 freezer piping is fed by a cross main from this riser, part of which and also part of the stringer line from same are piped through insulated partition. There was no other serious obstruction noted in the piping of this section, but there was a slight formation of frost in piping where in insulated partition.

This section is so arranged that water from frost or ice which may be located in the piping would run to the piping in the basement with drainage back to the dry-pipe valve.

Fig. 9. Cold Storage Building.

Summary.

Basing conclusions on the reports rendered by several inspection departments in 1915, the detailed examinations conducted by this Association at three separate plants, and ice found in sprinkler pipes at a fourth, and also the developments indicated by the test apparatus, as reported in the January, 1919, QUARTERLY, it is felt that automatic sprinkler protection under present standards of installation in cold storage warehouses is of doubtful value for the following reasons:

(*a*) that conditions, in the sharp freezers at least, approximate for practically the entire year those of a severe winter, and any accidental flooding will require a thorough examination of all of the

piping in the rooms below frost to make sure of the condition, and this is likely to cause air leaks.

(*b*) that ring or snowy ice can build up in time, depending on local conditions, in sufficient quantity to impair the protection, without accidental flooding of the system, and the danger is increased in the average property when the temperature of a sharp freezer is temporarily raised above freezing to clear refrigeration coils of ice, or is increased due to change in the character of the storage. In either case the ring or snowy ice is melted, and the resulting water will freeze again as hard or black ice on draining back to a cold section. Confirmation of this is believed to be found in Figs. 4 and 5, where the riser was found frozen at floor and ceiling.
(*Note.*—Ice was in the vertical piping, which, under normal conditions, should drain without question.)

(*c*) that some stocks will suffer a severe, if not total, loss at temperatures considerably below that necessary to fuse the ordinary degree sprinkler now used.

(*d*) that the time and expense involved to the average inspection department are not warranted in order to certify that an equipment is in proper shape, and further, there is no sure means of ascertaining the conditions without detailed examination.

On the other hand, it must be recognized that the danger of a fire starting in a refrigerator room in a fire-resistive cold storage warehouse is remote. A very heavy loss (about $500,000) was suffered in a fur storage room of ordinary construction in a fire-resistive building some eleven years ago, which is the only one on record here where a large number of heads opened, and the operation of the sprinklers was greatly delayed due to the long time required to raise the average temperature of the room. The slow action of sprinklers in refrigerator rooms in comparison with the ordinary property was also demonstrated experimentally by one of the inspection departments a few years ago.

Fire Hazards of Cotton Seed Oil Mills.

By T. C. Taliaferro.

Assistant to Chief Engineer, South-Eastern Underwriters' Association. (Member N. F P. A.)

The enormous losses sustained in recent years on cotton seed oil mills are, in the writer's opinion, the direct result of poor care and order, and of failure on the part of cotton seed oil mill men to properly recognize and eliminate this condition. To a close student of the industry this attitude of the cotton seed oil manufacturer is peculiarly puzzling. Disregarding the question of losses by fire, there is perhaps no class of business the economic success of which is more directly dependent on good housekeeping. In the manufacture of cotton seed oil, the earning capacity of a cotton seed oil mill, exclusive of profits obtained through market variations, is directly dependent upon good housekeeping. From the design of the mill buildings and the installation of machinery through to the very purchase of the seed itself the fire hazards incident to the process of manufacture are inversely proportional to the dividends declared.

Oil mills in general should be sub-divided into at least six good fire divisions. These divisions should be as indicated below:

(1) Seed House, usually of frame construction, should be detached not less than 60 feet.

(2) Seed cleaning machinery is usually in seed house or mill building. In either case it should be completely cut off with standard fire walls facing adjoining building.

(3) Linter Room is invariably in main mill building, but should be properly cut off from rest of building by standard fire walls.

(4 and 5) Press Room and Lint Press Room should each be separate fire divisions, cut off by standard fire walls.

(6) Hull House, which is usually of frame construction, should be detached at least 60 feet from other buildings.

The fire walls referred to above should be unpierced except for conveyor or shafting purposes which are essential to the processes of manufacture.

Usually in actual practice the seed and hull houses are properly detached and some effort is made to separate the main mill building into the subdivisions described, but only rarely are these subdivisions of the mill absolute, as the manufacturers insist on piercing the division walls with door and window openings. Such door and window openings are not essential to the operation of the plant, and their elimination should be insisted upon.

Hazards in seed houses where seed only is stored are those resulting from carelessness of employees in smoking or handling

matches, from improperly installed electrical equipments, and from fire originating in seed conveyors and seed tunnels. There is also ever present where large piles of seed are stored the danger of spontaneous ignition.

It must be remembered that the usual run of a cotton seed oil mill is only about eight months of the year. At the end of the year's busy season practically the entire force of unskilled labor is discharged until the beginning of the next season. This inevitably results in constant changes in the personnel of the employees. With skilled officials a cotton seed oil mill can be operated with a very low grade of unskilled labor, so that the dangers to be apprehended from carelessness and indolence are manifold.

Electrical equipments in oil mill properties as a whole have been carelessly installed, and, due to the unusually rough usage to which it is subjected during the rush seasons, the electrical equipment is usually found in a defective and hazardous condition. These facts, coupled with the dust and lint hazards, introduce an undesirable condition which should be clearly recognized. If electrical equipments in this class of property are installed in approved metal conduit in strict accordance with the rules and requirements of the National Electrical Code, the cost of upkeep and the hazards introduced will be reduced to a minimum. In addition to the rules of the National Electrical Code, certain special requirements should be observed. In seed and hull houses, where practicable, pendant lights and side wall receptacles should be avoided, and all light outlets in all buildings should be equipped with vapor-proof globes and metal guards of the approved marine type. It is especially desirable that these be used in seed tunnels and in linter and linter press rooms.

There seems to be considerable confusion on the subject of seed conveyors and seed tunnels. Practically all seed houses have seed conveyors. They run the length of the seed house, and consist of a metal screw conveyor about six inches in diameter, boxed in with wood or metal boxing. All-metal conveyors are recognized as standard. The covers to the conveyor boxings are removable, and seed is forked into them by hand. The hazards connected with conveyor systems are among the most serious and difficult to eliminate in cotton oil mill operation. A piece of foreign material, a rock, a wrench or a metal substance may be unintentionally thrown or kicked into the conveyor and cause fire. A hot bearing or an accumulation of lint on the shafting or bearings may cause disastrous results. The innumerable screws and bolts in the system work loose and become mixed with the seed. Dirt, trash, rocks, metal and other material are all carried by the conveyor together with the seed. So it is that the conveyor may cause fire in the seed house itself or may convey foreign material to the mill, there to deliver it to other more delicate machines wherein it is even more liable to cause serious trouble.

The amount of foreign material, such as matches, trash, dirt, nails, etc., is, of course, a variable quantity, but is a matter of serious moment. Mills have kept accurate account of the amount of dirt and foreign material extracted from seed purchased in bulk, and have found that in

a season's operations several thousand dollars were spent buying this undesirable material. Some mills are at present cleaning the seed before buying, and it is hoped that this may soon become the general practice throughout the industry.

Seed tunnels are built to house the conveyors in the seed houses. They are usually constructed of frame, although some which have been recently constructed are of non-combustible material. In cross section they are generally the shape of the letter V inverted. They are usually of such area as to permit a man to crawl or walk through them with difficulty. The sides are removable. Serious fires have occurred in seed tunnels, and they act as a flue to carry the flames through a pile of seed. For this reason seed tunnels are often sprinklered even though the remainder of the seed house may not be.

Spontaneous ignition of seed has been widely discussed, and the writer believes this question has caused greater concern than is warranted. The interiors of seed piles are often subject to excessive heating through chemical action, and this chemical action is commonly known as rotting or fermentation. It is dependent on many variables, chief among which are pressure and moisture content. The quality of the seed also has an important bearing on the question of heating. Seed grown in different sections and at different seasons of the year varies materially in chemical content. Some seeds contain more ammonia and others more oil, and these chemical differences in qualities of seed add materially to the vexing problem. It is commonly known that a comparatively small rise in temperature in the interior of a seed pile will cause such serious damage to the seed that a severe loss will necessarily be sustained by the manufacturer. Seed which has fermented slightly produces inferior oil, meal and hulls. Cotton oil manufacturers exercise great care to guard against this loss, and the interiors of the seed piles are carefully and frequently tested for the purpose of detecting undue heating. Various methods have been used to ventilate the bottoms of seed piles. Ventilating air ducts, seed bins with air spaces in the partition walls, the forcing of compressed air through perforated pipes run along the floor at intervals under the seed piles, and numerous other methods have been tried, but none have become universal and none may be considered as absolutely satisfactory. Proper ventilation will eliminate this heating.

Seed will ferment at a far lower temperature than the temperature of ignition, and must be materially damaged by fermentation long before spontaneous ignition occurs.

Seed is conveyed by conveyor system to seed cleaning machinery, the purpose of which is to extract the dirt and foreign material. This machinery consists of a sand and boll screen and a shaker. Electro-magnets are usually provided to extract foreign metal. Many fires have originated in seed-cleaning machinery. Owing to the fact that all of the dirt and trash pass into it along with the seed, the cleaning motion of the machine is peculiarly liable to strike fire. It is therefore considered good practice to provide automatic sprinkler protection for this machine wherever possible.

The problem of properly cleaning seed has never been satisfactorily solved. Even after the seed passes through the seed-cleaning machinery

it is far from clean. In addition to the foreign material in the seed when purchased, the conveyor system and the mill machinery contribute nuts, bolts, screws and pieces of metal which break off or work loose. A single article of this nature may cause total loss by fire. Electro-magnets have never proven entirely successful in extracting foreign metal. If kept clean and properly magnetized they operate with only fair success, and it is very difficult to keep them clean and in proper working condition. In addition to magnets and seed-cleaning machinery, what are known as drop or soft pockets are commonly used in conveyor systems. A section is cut out of the bottom of the conveyor system, and under the opening a small canvas pocket is made. This is designed to catch articles larger and heavier than seed, and in a measure does catch some of the foreign substances if kept clean. As stated, however, cleaning seed properly has never been perfected, and many fires occur from this source. A method for cleaning seed which has only recently been introduced is what is known as the air lift method. It is designed to pick up the seed by air suction and lift them away from other substances such as rock, gravel, sand and metal which have specific gravities heavier than seed. The writer believes that this method is most practical and, if put into general use, will materially reduce the hazards incident to cotton seed oil milling.

From the seed-cleaning machinery the conveyor system carries the seed to the linters or delinting machines, where the lint is cut from the seed. These machines are often equipped with magnets. They usually create a flying dust and lint hazard which is of a most serious nature even though they are equipped with lint rolls and individual condenser systems. The spark hazard is ever present, and the hot bearing hazard is an added danger. Lint may collect on the shaftings, bearings or pulleys and, balling up, cause fire. All other hazards of the linter room are intensified by the lint and dust which collect on the walls, the floor, the ceiling, the machinery, the shaftings and bearings, the electric light wires and cords. The air becomes filled with a stifling dust that is easily ignitible. Even though sweepers are kept constantly busy, it is almost impossible to control this condition unless the delinting machinery is equipped with cyclone blower and metal conveyor system. These systems have only come into use in cotton seed oil mills in recent years, and are similar to the cyclone blower systems which are in common service in connection with woodworking machines. They are most efficient in operation and relieve the linter room almost entirely of the lint and dust hazard. However, due to the fact that the lint which is collected by these blower systems has a tendency to curl, the manufacturer has greater difficulty in marketing it than in marketing the lint collected by the individual condensers. For this reason the introduction of these blower systems into general use has been greatly retarded. From the fire hazard viewpoint they should be insisted upon.

After the seed is delinted it is conveyed to the hullers, which operate to separate the meats from the hulls. There are two types of hullers in use, the bar huller and the disc huller. In actual practice the seed is run through two hullers, and usually the first huller is a bar huller and the second a disc. The bar huller operates with a knife or cutting effect,

thus separating the meats from the hulls, while the disc operates on the principle of an attrition mill with a rubbing effect under sufficient pressure to remove the meats from the hulls. The bar huller will strike fire from pieces of metal or gravel passing through with the seed, and fires often originate from this cause. The disc huller will also cause fire from foreign substances in the seed, and in addition to this balls of lint are liable to clog this machine and be set on fire by the rubbing of the plates.

There is a wide diversity of opinion as to the comparative hazards of the two machines, but many practical manufacturers claim that the disc huller for first hulling is by far the more dangerous. Therefore, as a rule, the seed passes through a bar huller and the disc huller is used for second hulling, as it is claimed that as a second huller it prepares the meats better for the oil press.

Leaving the huller, the hulls are conveyed to the hull house, and the meats are conveyed to the press room, where they are cooked by steam. There are no severe hazards in the press room other than the fact that most press rooms are so situated that they communicate directly with the linter room, and the lint and dust from the linter room drift into the press room through the openings and create a lint and dust hazard. Filter press cloths which are used in the presses should be properly cared for, and as soon as used should be removed from the mill, as they are subject to spontaneous combustion. After the oil has been pressed from the meats it is conveyed to the oil tanks, which should be of non-combustible material on non-combustible foundations, with non-combustible covers. Cotton seed oil has a deleterious effect on rubber, and therefore the drain valves of these tanks should not be provided with rubber gaskets. The bad effect which cotton seed oil has on rubber is intensified by heating; consequently if the rubber gaskets are used in the drain pipe and the tank filled with oil is heated from an exposure fire, there is a serious chance of the rubber gaskets disintegrating and the oil in the tank being lost through leakage. Cotton seed oil is not easily ignited, and though exposed to nearby fire will not be destroyed if in non-combustible tanks. The heating of the oil, however, will badly discolor it, and material loss from discoloration be sustained if sufficiently high temperature is reached. Cotton seed oil in tanks with combustible covers may be considered under certain conditions subject to total loss. Wood coverings on tanks have been known to catch fire, causing fire brands to drop into the oil tanks. These burning pieces of wood in the oil tanks act just as a wick in a lamp, and the oil is consumed until extinguished. Accordingly cotton seed oil tanks should be well detached in addition to being built of non-combustible material throughout and supported on non-combustible foundation.

After the oil has been pressed from the meats, the cakes of cotton seed meal are removed from the presses and are broken up by attrition mill into finely divided particles of cotton seed meal. This meal is conveyed usually to the hull house, sometimes to a separate meal house.

The linters from the linter room are conveyed either by conveyor system or by hand to the linter press room. They are there pressed into bales by an ordinary single box press, and should be removed from the

mill as promptly as possible, as serious fires have been caused by these baled linters.

Recently serious fires of unknown origin have occurred in hull houses, and these fires have led many to believe that the question of spontaneous ignition of hulls is a most serious matter. Hulls which have been stored in the hull house for months and, so far as could be learned, have been undisturbed during that length of time, have suddenly taken fire and caused serious losses. Oil mill manufacturers who have had years of experience claim that spontaneous combustion of hulls is not probable, and that the danger in a hull house, as a rule, lies in the fact that the conveyor systems convey smouldering hulls or lint into the hull house, and that these are buried in the pile of hulls before they are detected. If such burning particles are buried deeply it is quite possible that the smouldering might continue for some time without any external signs of combustion. No clear and definite decision has as yet been reached on this subject, so far as the writer knows, but the fact is established that many fires in hull houses originate in the mill building.

In addition to the usual hazards met with in the actual manufacture of cotton seed oil, there is usually present the railway spark hazard and very often hazards incident from burning grass, broom sage or trash. Constant change in employees usually results in poor organization and unfamiliarity with the plant and its protection and lack of interest in the owner's welfare.

Summarizing the various hazards incident to the processes of manufacture of cotton seed oil, the hazards in the seed house result from carelessness of employees, from electrical equipment, from fires originating in seed conveyors and seed tunnels and from spontaneous ignition of seed. The linter room hazards are from sparking, and the lint and dust hazards. The press room hazards and those of the linter press room and the hull house are all directly dependent on the care and order of the plant. The conveyor system hazards are most serious all over the property. The hot bearing hazard is intensified by the dust and lint accumulation and the poor alignment which is often obtained in the conveyor system. In addition to this, the machinery in the linter room and the seed-cleaning machinery is all fast-moving. Usually it is mounted on substantial foundation, but the slower-moving machinery in the seed house and hull house is often without secure foundation, and this adds to the danger.

A satisfactory mill management will use extreme care in the purchase of seed to avoid obtaining seed which is unusually liable to heating, and will secure the cleanest seed it is possible to secure; every precaution will be taken to see that fermentation of the seed stored in the seed house is prevented; the operatives will be organized into an efficient private fire brigade; smoking and the carrying of matches will be prohibited; careful attention will be given to the conveyor system and every effort will be made to obtain the proper alignment, to avoid the hot bearing hazard and to reduce to a minimum the shaking loose of bolts, screws and other metal substances. Everything possible will be done to have the seed thoroughly cleaned; seed-cleaning devices will be placed before each individual machine through which the seed passes.

The dust and lint hazard in the linter room will be reduced to a minimum; the meats will be thoroughly separated from the hulls and the hulls will be properly stored in the hull house; linters will be promptly baled and removed from the mill building, and only the most modern improved machinery will be used.

Comparing the class of machinery which is in use with the remarkable advances which have been made in the production of cotton seed oil and its by-products, cotton seed oil mill machinery is astonishingly crude, and the management of a mill must be very efficient in order to obtain the best results.

It is believed that if the same good class of machinery, the same general care and order, and the same standards of construction and protection could be maintained throughout the cotton seed oil mill industry as in the cotton manufacturing industry, the fire losses in the two classes would approximate each other.

Department of Fire Record.

Cotton Seed Oil Mills—Fire Record.

The detailed account of the hazards of cotton seed oil mills which appears elsewhere in this issue of the QUARTERLY should be read in connection with this record.

It will be noticed that very few examples of fire causes are given. The reason is that the hazards of this class of property, though severe, are generally well understood and call for special means of protection rather than prevention. The stock fires are of interest, however, as showing that, quite apart from any discussion of the spontaneous combustion hazard, fire may smoulder undiscovered in the hull house for quite a long period—a fact which assumes great importance when it is remembered that this industry has an annual idle season.

The value of sprinkler protection, of proper fire divisions and of good management as means of keeping losses at a minimum is abundantly clear. Of the 21 fires involving no claim, 18 were in sprinklered plants, although the total number of sprinkler fires was only 69 out of 204 covered by the record. In the "large loss" class of fires only 14 out of a total of 109 occurred in sprinklered properties. That this form of protection should be so widely neglected where the need for it is so great reflects little credit on the cotton seed oil industry. Apparently, however, similar carelessness prevails also in the matter of fire divisions. Instances will be found collected under the heading "Fire Divisions."

One would expect that for an occupancy involving the presence of lint in oil-soaked buildings fire-resistive construction would be the rule instead of the exception, and that where fires may so easily be spread through conveyor systems special thought would be given to the problems of private fire protection. The testimony of the record, however, is that in both respects the dictates of safety are generally ignored, and the result is that 60 per cent. of the fires entail heavy losses.

If, as seems to be the case, it is only human indifference which prevents the hazards of the cotton seed oil mill from being as well taken care of as those of the ordinary cotton mill, the duty of the cotton seed oil men to cultivate a new attitude is obvious.

COTTON SEED OIL MILLS—FIRE RECORD.

Total Number of Fires Reported, 204.

1. Classification of Causes.

Common Causes.

	No. of Fires.	Per Cent. of Common Causes.	Per Cent. of Known Causes.
Lighting	5	15.1	3.2
Power	10	30.3	6.5
Lightning	6	18.2	3.9
Smoking (or matches)	2	6.1	1.3
Boiler (or fuel)	3	9.1	1.9
Locomotive Sparks	5	15.1	3.2
Miscellaneous	2	6.1	1.3
Total	33	100.0	

Special Hazard Causes.

	No. of Fires.	Per Cent. of Special Causes.	
Linter	35	29.7	22.6
Huller	21	17.9	13.5
Gin	17	14.4	11.0
Stock fires	16	13.5	10.3
Conveyor systems	11	9.3	7.1
Seed cleaning	5	4.2	3.2
Spontaneous combustion in sacks or cloths.	4	3.4	2.6
Cake mills	4	3.4	2.6
Miscellaneous	5	4.2	3.2
Total	118	100.0	
Common Causes	33		21.3
Special Hazard Causes	118		76.1
Incendiary	2		1.3
Exposure	2		1.3
Total known causes	155		100.0
Unknown causes	49		
Total	204		

Details of Causes.

Under this heading are given brief descriptions of fires caused by unusual conditions or of an educational value in emphasizing the different hazards. Fires caused by ordinary conditions or well understood hazards may not be included.

Common Causes.

Lighting.

H-9484. An incandescent electric light globe, located about two feet above a linter roll, burst and dropped hot glass and molten metal on the cotton below. The accident was due to the negligence of an engineer who left the electric generator which supplied current to the plant unattended for about half an hour. The voltage ran up far above the normal, with the result that some of the lamps burned out and others burst. The loss was $8,500.

Locomotive Sparks.

H-7685. Fire is believed to have been caused by a spark from a freight train locomotive. The windows facing the track were unprotected and were open at the time of the fire. The building was frame ironclad construction, and the loss was practically total.

H-9973. Sparks from the engine of a passing train ignited dry grass near linter storage building. Fire attacked linters through a 10 x 16-inch ventilator at ground level. The ventilators at the bottom of the building caused a draft and fire flashed all over the baled linters, rendering them difficult to handle. The management was afraid to roll out the baled linters on account of a high wind blowing in the direction of the main building. The entire stock of linters was destroyed. The loss amounted to $6,516.

Special Hazard Causes.

Stock Fires.

H-653. This was a case of spontaneous combustion in a hull warehouse. Careful investigation showed that the cause was probably foreign matter carried into the hull house by conveyor from the oil mill. It is believed that the employee who was detailed to remove the lint which collected on the journals of the huller machine found it easier to drop the oily waste into the conveyor which passed under the machine than to place it in the metal cans provided for the purpose. The waste was thus carried into the hull house and covered with hulls, the resulting spontaneous combustion entailing a loss of about $2,500.

H-759. Laborers were shovelling cotton seed hulls into cars on side tracks, when fire was discovered in a pile. The removal of hulls from the top of the pile permitted air to reach the smouldering fire in the middle, and this burst into flame, doing damage amounting to $420. It could not be determined whether the hulls had been stored while damp

or whether a leaky warehouse roof had permitted them to become wet, thus causing spontaneous combustion. It was also considered possible that a locomotive spark might have entered the warehouse through an open window and have smouldered in the middle of a pile of hulls.

H-12348. Fire was discovered in hull house on January 15th. Apparently fire had been carried into the house from the main mill while the latter was in operation prior to December 21st, and had smouldered from ten to twenty feet deep among the hulls before it was discovered. The building and contents were a total loss.

Miscellaneous.

H-7351. Damage amounting to $21,200 resulted from this fire, which started in the press room after the plant had been shut down for twenty-four hours. It is believed that the trouble originated in dust meal which was allowed to accumulate on top of the cooking vats, and which had been found smouldering some weeks before the fire. Caked and charred meal burned very fiercely when it was scraped off the top of a vat on this previous occasion.

Miscellaneous Statistics.

2. Analysis of Loss.

	Common Causes		Special Causes		Unknown, Incendiary, Exposure		Total	
	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.
No Claim	4	15	17	15	..	..	21	11
Small Loss	6	22	43	39	3	7	52	29
Large Loss	17	63	51	46	41	93	109	60
Total with data given	27	100	111	100	44	100	182	100
No data	6		7		9		22	
Total	33		118		53		204	

3. Day or Night Fires (Day Fires 6 a.m. to 6 p.m.)

	Common Causes		Special Causes		Unknown, Incendiary, Exposure		Total	
	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.
Day	14	47	49	44	15	29	78	40
Night	16	53	62	56	36	71	114	60
Total with data given	30	100	111	100	51	100	192	100
No data	3		7		2		12	
Total	33		118		53		204	

4. Plant in Operation.

	Common Causes		Special Causes		Unknown, Incendiary, Exposure		Total	
	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.
Plant in Operation	21	70	89	79	19	40	129	68
Plant not in Operation	9	30	23	21	29	60	61	32
Total with data given	30	100	112	100	48	100	190	100
No data	3		6		5		14	
Total	33		118		53		204	

5. How Discovered.

	Common Causes		Special Causes		Unknown Incendiary Exposure		Total	
	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.
Employee	20	64	78	68	16	33	114	59
Watchman	8	26	30	26	21	43	59	30
Sprinkler Alarm	..	..	2	2	..	..	2	1
Outsider	3	10	4	4	12	24	19	10
Total with data given..	31	100	114	100	49	100	194	100
No data	2		4		4		10	
Total	33		118		53		204	

SPRINKLER FIRE RECORD.*

6. Effect of Sprinklers.†

	No. of Fires.	Per Cent.
Extinguished or Practically Extinguished Fire	36	52.2
Held Fire in Check	22	31.9
Unsatisfactory	11	15.9
	69	100.0
No Claim	18	26.1
Small Loss	35	50.7
Large Loss	14	20.3
No data	2	2.9
	69	100.0

7. Number of Sprinklers Operating.

No. of Sprinklers Operating.	Extinguished Fire		Held Fire in Check		Unsatisfactory		Total	
	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.
1	10	27.8	2	9.5	..	..	12	19.0
2	6	16.7	2	9.5	..	..	8	12.7
3	4	11.1	1	4.8	..	..	5	7.9
4	1	2.8	2	9.5	..	..	3	4.8
5	2	5.5	..	..	..	..	2	3.2
6 to 9 incl.	4	11.1	1	4.8	1	16.7	6	9.5
10 to 24 incl.	6	16.7	7	33.3	..	..	13	20.6
25 to 49 incl.	3	8.3	1	4.8	..	..	4	6.4
50 and over	..	..	5	23.8	5	83.3	10	15.9
Total	36	100.0	21	100.0	6	100.0	63	100.0

*There were 3 fires in which no sprinklers were opened.

†6 fires included in this table are omitted from Table 7 owing to insufficiency of data.

Unsatisfactory or Large Loss Sprinkler Fires.

S-3504. About fourteen hours prior to this fire a small blaze, probably due to spontaneous ignition of oily refuse around the base of a hull baling press had been apparently extinguished by watchmen and night firemen with water pails. There was a concealed space beneath the building and the fire probably continued to smoulder there until discovered for the second time. An open drain ditch extended beneath the hull house in which the fire originated and also beneath adjoining buildings, all the brick foundation walls supporting the floors being pierced by the ditch. There were no sprinklers in the spaces under the buildings, and these could only be entered through an open culvert. Gridiron ventilators in the foundation walls under the hull house afforded an excellent draught, and the fire spread rapidly in the concealed spaces.

There was considerable delay in getting the fire department apparatus into operation, and the sprinkler equipment in the hull house and adjoining hull and meal storage house was of an old type, poorly maintained.

As there was no steam pressure in the boilers when fire was discovered, valuable time was wasted before the fire pump could be used. It was then found impossible to maintain any but a very light pressure, and the main valve at the pump was accordingly closed, hose being attached direct to the pump. This deprived the sprinklers of the benefit of the pump, leaving them dependent upon an 18,000-gallon tank supply. It was subsequently discovered that two lead joints in a 4-inch main which was exposed where crossing the drain ditch under the hull house had been melted by the heat and this condition was undoubtedly responsible for the pump failure.

When the fire penetrated the floors supporting large quantities of seed and hulls it had gained too great headway to be controlled by the poorly supplied sprinklers, and five buildings were practically destroyed.

S-4608. Fire originated in huller, and extended to all parts of the mill through unsprinklered frame conveyor chutes leading from the huller. Sprinklers operated promptly, but owing to poor water supply were unable to control fire. Hydrants and sprinklers were supplied in common from a 10,000-gallon tank only slightly elevated, a small trade pump (300 gallons) drawing from a 25,000-gallon reservoir and a 4-inch city connection of doubtful value (dead end of ½ mile). The check valve which was supposed to be in the city connection was subsequently found to have been removed, and the supposition is that the entire content of the gravity tank had been emptied into the public mains when the city pressure fell below that of the tank. Sprinklers which operated in the hull house were a factor in preventing the spread of fire beyond the oil mill proper. The loss exceeded $29,000.

S-8174. The building in which fire occurred was partly destroyed

with a loss of about $15,000. The fire, which was not discovered until it had gained considerable headway, was extinguished with hose streams. The sprinklers were old-style pendant heads supplied by pumps and standpipe with muddy river water. Investigation after the fire showed that in all 115 sprinklers had operated. As the general conditions seemed favorable to sprinkler efficiency, the system was thoroughly examined, and large deposits of mud were discovered in heads, fittings and pipes. Some of the smaller pipes were solidly filled with sediment, and it was evident that even the heads that were not clogged did not receive an adequate supply of water.

S-12097. This was a very large ironclad mill with composition roof. Its area was about two acres and there were no fire stops. Fire occurred at 10.30 a.m. in unsprinklered seed-cleaning machinery. The sprinkler equipment was dependent upon a 25,000-gallon gravity tank as primary supply, fire pumps as a secondary supply, and city water as a tertiary supply. Half an hour after the fire started the tank was found to be empty; the fire pumps were inoperative, as steam had been cut off for fear of an explosion, and the reservoir was empty pending repairs; the gate valve on the city main was usually kept closed. The firemen had a difficult task owing to the failure of the water supplies, which rendered the sprinkler equipment and yard mains useless. Three steamers were used, pumping through lines of hose from 500 to 1,000 feet in length. The plant was completely destroyed.

S-14063. Foreign matter in a linter was the cause of this fire, which spread rapidly owing to the crowded and inflammable occupancy of the room. A slatted ventilator on the roof caused the fire to run along the entire roof, opening a number of sprinklers. As soon as high pressure was put on the city mains, from which the sprinkler system was supplied, a three-inch tee broke, crippling the whole equipment. The accident was due to a crack in the fitting which had rusted up sufficiently to make it tight. The sprinklers were on a dry-pipe system, and the normal pressure was not high enough to cause a break. Seven linters, practically all the belting in the room, and a large quantity of meal in bags were destroyed, and the roof was so badly damaged that about half of it had to be replaced.

S-23778. Fire occurred from unknown cause and was discovered at 9.30 p.m. by watchman, who noticed flames issuing from basement windows. The mill had been closed for the summer about two and a half months prior to the date of the fire. The flames spread rapidly through the basement along the under side of an oil-soaked wood floor, and seem to have penetrated the floor at a point where a bucket elevator, extending from the basement to the second floor, was located. The basement was not sprinklered, but there was a sub-standard equipment on the first and second floors. All the sprinklers operated and the water supply was sufficient; but the damage to the mill building was very heavy. The roof was entirely burned off, the second floor almost entirely gone, and the first floor severely damaged. It was stated by the management that the sprinklers were of service in keeping the fire down and preventing its spread to adjacent buildings.

Points of Interest from Fire Reports.

Automatic Sprinklers.

S-7012. Fire occurred in linter room and spread rapidly owing to the inflammable character of the occupancy. The first sprinklers to open were clogged with mud, thus allowing the flames to gain further headway. In all, 37 sprinklers operated and held the fire in check. Two hose streams were used to complete the extinguishment.

S-13161. Spontaneous ignition of oil-soaked overalls, which had been left in a dressing room when the mill shut down, was the cause of this fire, which occurred about a week after the commencement of the idle season. One sprinkler operated and extinguished the fire without loss, while the sprinkler alarm called attention to the blaze. The sprinkler equipment undoubtedly prevented a large loss, as in the absence of such protection the fire would probably not have been noticed until it had gained great headway.

H-6315. A number of unsprinklered buildings were destroyed in this fire, which, however, is interesting as showing the value of sprinkler protection under severe exposure conditions. In the sprinklered oil mill building thirteen sprinklers operated and held fire out where wood conveyors from the burning structures entered through brick walls. There were four pent houses on the roof of the mill, and all were destroyed, but a single sprinkler head in each availed to prevent fire from entering the mill.

Hydrants and Hose Houses.

H-10974. Oil mill, boiler house and engine room, seed house and storerooms were destroyed in this fire. Oil tanks were also damaged and four freight cars burned. Private hydrants were used at first, but the water pressure was very low. On the arrival of the fire department public hose were connected to the private hydrants as well as to public hydrants located from 500 to 700 feet distant. The rapid spread of the fire compelled the abandonment of the private hydrants and the loss of considerable hose.

H-11219. This fire had gained great headway when discovered, and was not subdued until the hull house, meal house and storage buildings had been practically destroyed. There seems to have been no lack of water pressure, as eleven or twelve hose streams under good pressure are said to have been used. One of the hose houses, being located too close to the hull house, was burned.

These two fires indicate the need for care in locating fire protective apparatus, particularly in relation to frame structures. Ample space should be allowed to prevent the disablement of the apparatus when most needed.

Fire Divisions.

H-57. Fire is believed to have started as the result of the blowing of an electric fuse on the first floor of the oil mill. A small fire had previously occurred from this cause when engine operating dynamo in boiler house was left without an attendant. Fire communicated by way of a box freight car to frame covers of oil tanks located forty feet distant from the car and fifty feet from the building. The oil in the tanks was considerably heated by the fire in the mill, and when the covers caught fire and fell in the burning debris acted on the heated oil like a wick, and continued to burn as long as there was any combustible material left. **Had the tanks been detached a safe distance and provided with proper metal covers there is little doubt that the oil could have been saved.**

A blank parapet wall between the oil mill and the boiler house prevented the fire from communicating through the boiler house to the seed house. The mill and hull house were totally destroyed.

H-58. When fire was discovered north end of frame ginnery was in flames, and whole building was soon enveloped. It is stated that flames from the ginnery soon stretched in a solid sheet to the tank (located 90 feet distant) upon which the plant hydrants were dependent for their water supply. The tank caught fire first at the top, and as the fire burned down the joints below opened up, allowing the water to pour out so that the tank was entirely empty before it fell. From the ginnery the fire spread to the blacksmith and carpenter shop and thence to the meal and hull houses, which were rapidly consumed. Two 20,000-gallon oil tanks located between the hull house and the mill, and practically adjoining both, next caught fire. The tanks were entirely of iron and on brick supports, but the oil made a very hot fire, burning with a very dense smoke. At this point the flames were arrested for quite a while by the blank wall of the cake room, but this wall finally crumbled under the extreme heat, allowing the fire to enter the cake room and to spread successively to the press and linter rooms, seed house and stable. The fire doors in division walls, though not standard, seem to have been efficient, for while the woodwork was entirely consumed the shells were found hanging in place after the fire, and apparently the flames did not spread through the doorways. The division walls on each side of the press room were in fair condition up to the level of the eaves, but failed altogether above this point.

As the plant was shut down on the day of the fire, no steam was available for the fire pumps, and before a fire could be built under the boilers the stack fell, due to the fact that guy wires were attached to or near the frame buildings which burned.

Had the tanks in this case been located at a proper distance from buildings the mill and machinery would undoubtedly have been practically uninjured. The fire also emphasizes the importance of having the different sections protected by standard fire walls.

H-4024. The plant was a total loss. Fire originated in hull storage, but owing to inadequate separation of buildings it was impossible to confine the fire to the section in which it started.

H-5805. Heavy loss was caused by fire in seed house of large unbroken area. It is interesting, however, to note that a 12-inch brick wall, with 8-inch parapet, prevented the destruction of the entire plant.

H-8823. A hot box on seed-cleaning machinery was the probable cause of this fire. Lint dust accumulated on roof timbers facilitated the rapid spread of fire over the ceiling of the seed house. In the excitement following the alarm, the mill machinery was left running, and practically all the employees in the mill went to the seed house. Thus the flames first gained entry to the mill along a screw conveyor from the seed house. Fire was also communicated direct to the mill, as its exposed walls were not standard and there was considerable lint and refuse between the buildings. The ginnery caught fire in like manner. The seed house, mill building and ginnery were practically destroyed with most of their contents. The boiler room was damaged. Only a change of wind saved the hull house.

H-10028. This fire was confined to the oil mill in which it originated. Starting in the linter room, which was crowded with machinery and in which an excessive quantity of lint had been allowed to accumulate, the flames spread with great rapidity and swept through a large unprotected belt opening between the linter room and the engine room, practically destroying the entire contents of the latter. Through an opening protected by a sub-standard fire door fire communicated from the engine room to the boiler room, the roof of which was completely destroyed. Although the openings between the linter room and press room and engine room and press room were protected by double standard fire doors, the flames were carried from the linter room into the press room by a wood boxed screw conveyor passing through the fire wall which separated them. Practically the entire roof of the press room was burned off, floors sustained considerable damage and machinery was slightly damaged. The blank parapetted fire wall between the engine room and meal room and the fire wall between the press room and cake room acted as a complete fire-stop.

H-11379. Without notification to the inspection department having jurisdiction, the management of this mill removed the southeast wall of the linter room between that room and the cake room, and built a frame extension of the southwest wall to separate the remainder of the cake room from the linter room. This alteration considerably increased the size of the linter room and destroyed the cut-off between the linter and cake rooms. At the same time a doorway was cut between the seed-cleaning room and the linter room extension.

Fire was discovered by an employee in the seed house about the elevator. This fire was extinguished with fire pails and chemical extinguishers. When the alarm was given, all the employees except those in the press room left their posts, and consequently when fire was carried by the conveyor from the seed house to the seed-cleaning room it was not immediately discovered. It was not until the fire had spread from the seed-cleaning room into the linter room through the unprotected door opening already mentioned that it was noticed by an employee in

the press room. The flames had now gained such headway that they could not be extinguished. The fire door at the entrance to the engine room operated satisfactorily and saved that room and the boiler house. The fire doors between the linter and press rooms, however, closed only part way, jamming against the door sill. With the exception of the engine room and boiler house, the mill was destroyed. On the following day the fire in the seed house rekindled, and the seed and meal houses were consumed.

Construction.

H-7299. Fire was discovered in basement of pressing and grinding room. The basement had no outside openings, and by the time these could be made and hose streams introduced the fire was beyond control, having attacked the floor above, which was covered with meal cake that burned as fiercely as soft coal. The building was a total loss.

H-10652. The hazards of oily frame construction are well illustrated by this fire, which entailed a loss of $52,832. The flames gained such rapid headway as to be observed at an engine house half a mile away almost simultaneously with the receipt of the telephonic alarm.

H-11378. It is supposed that fire originated from the overheating of a friction speed reducer in the seed house. As no one was present in this part of the house and as the elevating and weighing machinery was not partitioned off, fire quickly spread over the entire building. The flames also communicated to an enclosed space under the floor through concealed spaces in walls which were sheathed on the inside as well as outside.

Another feature of the fire was its inaccessibility. Seed was stored around the main doors and the house was as full as possible; the dense smoke and heat prevented the firemen from getting through the roof; all but one of the outside openings were blocked, and the seed was piled so near the roof that hose streams could not be played on the fire after it had spread over the entire house.

H-11804. This was a $72,000 fire. The construction was brick, with wood floors. The floors were oil-soaked and there were accumulations of lint throughout the rooms. Fire spread very quickly, and the building was practically a total loss.

General Fire Record.

Stationary Chemical Extinguisher with Sprinkler Heads in Operation at Boston Fire.

Special Report by Underwriters' Bureau of New England, Gorham Dana, Manager.
(Member N. F. P. A.)

On May 5th, 1919, fire occurred in a plant consisting of a single small four-story and basement brick and mostly sheathed joist building in a built-up city block. The building was occupied by a concern buying and selling dyes and coloring material used in the manufacture of cotton, woolen and leather goods. The occupancy was of a mercantile character, with offices, but included the grinding and mixing of dyestuffs, although no processes of a manufacturing order were carried on.

The building was equipped with a stationary chemical extinguisher with sprinkler heads, installed in 1917. There were four sprinkler heads overhead and two under a deck in the poorly partitioned space in which the ball mill responsible for the fire was located. While a charge of "palachrome brown" was being reduced from a lumpy state to a powdered form, a violent puff or moderate explosion occurred in the mill, resulting in severe burns to one of the employees. It is probable that the mill was stopped and the cover plate removed, and that the inrush of air on removal of the cover gave violence to combustion already started in the material by the action of the mill.

The loss on contents was $5,263.60, and on the building is estimated at about $2,000.

The small amount of this loss may be considered as a very satisfactory showing under existing conditions. This is the most severe test to which, so far as we know, an extinguishing equipment of this description has ever been subjected, and it is interesting to study the results in some detail.

Story of the Fire.

The fire started on the top floor in a metal "ball mill," an iron cylinder somewhat larger than a barrel, with a hand hole about a foot square. The mill contained a charge of dye described by the firm as "palachrome brown," but known chemically as "metachrome brown." This is a hazardous material prepared from picramic acid and meta toluylene diamine. The hand hole was probably open and the cylinder was in such a position that the hole pointed toward the windows somewhat above the horizontal. Flame issuing from the barrel shot out in a sheet toward the rear windows and scorched shutters twenty feet or more away. The room in which fire started contained considerable combustible material in the form of shelves and barrels of dyestuffs, and was partitioned off from rest of floor by a light board partition. It was

badly burned except near floor level. Outside of this room there was not a large amount of combustible material, except the wooden barrels of dyes on the floor, as the walls were brick and the ceiling plastered. However, the fire spread around the upper parts of this floor, charring some wooden partitions and a shelf located about twenty feet from the ball mill along the east side of the room. Several belts were badly injured. There is little sign of charring near floor level, and barrels of dyes were not apparently damaged by fire. The smoke was said to be heavy and nitrous fumes were given off. This prevented the firemen from entering this floor beyond the stairway for some minutes.

Extinguishment.

The stationary chemical extinguisher with sprinkler heads operated promptly and the contents of the 200-gallon tank were quickly exhausted through the large number of sprinklers that opened. Carbonic acid gas was probably discharged for some time after the liquid had been exhausted. The marks on the ceiling show that some liquid was discharged from a large percentage of the 49 heads that opened, but except for the few that opened first, the amount discharged from each must have been very small.

The system was designed to care for a "three sprinkler fire," and was meant for occupancies of light hazard. The chemical solution in the tank will feed three sprinklers for approximately fifteen minutes, and the material discharged, being the same as that in a 2½-gallon hand chemical, consists of a solution of sulphate of soda in water and carbonic acid gas. The equipment was installed in this building under the impression that there were no serious hazards present, but this fire proved that such was not the case.

The carbonic acid gas discharged probably assisted in holding the fire. While many windows were broken at the start of the fire, thus causing a draught which would tend to dissipate the gas, still it is probable that gas collected near the floor below the window level in considerable amount, and this is borne out by the absence of any appreciable charring within a couple of feet of the floor.

A fire department official estimated that the department used about 500 gallons of water in addition to the one chemical stream, but this estimate would appear to be rather low.

When the Bureau inspectors reached the building about twenty minutes after fire started, the chemical system had been exhausted, but considerable fire remained, especially under benches and in hollow partitions. There was a large amount of water on floors and running down stairs and elevators.

While it is difficult to determine just how much value the chemical system was in this fire, it seems safe to say that it assisted in holding the fire in check and probably prevented a much heavier damage. It is certain that it operated promptly and accomplished all that could be expected under the circumstances.

Fire at St. Mary's Industrial School for Boys, Baltimore.

April 24, 1919.

Special Report by Association of Fire Underwriters of Baltimore City.

(Member N. F. P. A.)

The general occupancy of the burned buildings was as follows: reform school for boys, containing classrooms, repair and carpenter shops, bakery, dormitories, hospital and chapel.

Construction.

Construction throughout was ordinary, with stone walls for the main part. Exceptions to this are to be noted in the reinforced concrete fire-resistive chapel on the west and the stone and concrete six-story tower at the north.

Heights were 1, 3, 4, and 5 stories, varying from 40 to 70 feet, with the exception of the tower, which is 120 feet to roof. All supporting members in fire-resistive building are protected in an approved manner. Steel and cast-iron structural supports in the ordinary construction portions were, for the most part, unprotected. Where protected, a light sheathing of expanded metal and plaster seems to have been the prevailing form. All roofs were of ordinary construction, tin-clad, except where of fire-resistive construction on fire-resistive portions. A wood slate-clad mansard covered the entire roof line of the main central group of buildings.

The interior finish of all the buildings of ordinary construction was wood lath and plaster on wood furring strips. Floor openings were unprotected throughout. Stone buildings of ordinary construction and the fire-resistive tower communicated on all floors through unprotected openings. The fire-resistive chapel on the west communicated with the above buildings through fire-resistive corridors with ordinary tin-clad roofs. Each opening to these corridors was protected on each floor by a single sliding automatic three-ply tin-clad fire door.

Hazards.

All common hazards properly protected.

Fire Protection.

The private fire protection consisted of an inadequate and sub-standard standpipe and hose system consisting of two 3-inch standpipes and two 2-inch standpipes located in the buildings of ordinary construction. These standpipes were supplied from storage tanks, reported to be of approximately 25,000 gallons capacity, located on the top floor. These tanks were supplied by 4-inch metered connection to a 4-inch main of the Baltimore County Water and Electric Company. Each standpipe was supplied with approximately 100 feet of 2-inch and 3-inch hose (according to size of standpipe) and nozzle on each floor.

This school was situated just south of the old southern boundary of Baltimore City, and was under the protection of the Baltimore City Fire Department and also the volunteer and paid fire departments of the neighboring localities.

Two hydrants were within 100 feet of the west end of the buildings which were damaged. Hydrant No. 1 was supplied from a 4-inch dead-end main of the Baltimore County Water and Electric Company, and was a three-way hydrant. Hydrant No. 2 was supplied from a 6-inch main of the same company, located in Wilkens Avenue, and was also a three-way hydrant. Hydrant No. 1 had been tested by this office and was not approved. Hydrant No. 2 had also been tested by this office and was approved.

Other hydrants in the vicinity which were used at the time of the fire are as follows: hydrant No. 3, about 1600 feet north of hydrant No. 2; hydrant No. 4, Caton Avenue, about 750 feet east of hydrant No. 2; hydrant No. 5, on Wilkens Avenue, about 2000 feet east of hydrant No. 2. These hydrants were supplied by the Baltimore City Waterworks; were approved three-way hydrants on 6-inch mains; and were from 50 to 80 feet below the grade of the burned buildings.

Story of Fire.

During the day of April 24, 1919, a tinner had been at work on the east end of the tower building repairing a portion of the roof and cornice. In order to accomplish this work, it was necessary to expose a goodly portion of the roof sheathing. A high wind blew over the charcoal pot which the workman was using, and scattered the burning coals over the exposed roof surface. The tinner claims to have collected all of the coals, placed them in the fire pot, and left the roof about 3.30 p. m., bringing the charcoal pot and his overalls, which had been burned, with him.

Some of the scholars discovered the fire about 4.30 p. m. in the vicinity of the roof referred to above. The private fire brigade, consisting of the scholars and their instructors, was immediately called into action and the various standpipes throughout the buildings placed in service. After fighting the blaze for about twenty minutes, it was discovered that the water supplies were extremely low and that no headway was being made. A telephone call was sent to the Violetville Volunteer Fire Department, and at practically the same time an outsider turned in a fire alarm through the Baltimore City fire-box in the vicinity. Upon the arrival of the Chief on the third alarm, the entire roof of the central portion was burning. A strong west wind, reported as blowing thirty miles per hour, carried the fire to the extreme east end of the building. The large amount of water being used from hydrants Nos. 1 and 2 made it impossible to secure a hose stream which would reach higher than the second story. Two hose lines of 2000 feet each were then connected at hydrant No. 3 and hydrant No. 5, each being supplemented by a fire department steamer. Due to the great distance, it was necessary to pump this water, and also owing to the fact that these hydrants were considerably below the level of the fire, these streams were of little value. Finally two good hose streams were secured by

running a fire department steamer down a 15-foot bank and pumping water from a stream crossing Wilkens Avenue, about 2200 feet east of hydrant No. 2. This steamer pumped the water to a second steamer about 1000 feet away, which in turn relayed the water to the hose being used in an effort to get the fire under control and save the adjoining property.

Loss of Life and Injuries.

About 8.00 p.m. the floor of the west section of the main building collapsed and buried about forty firemen. Thirty-six of these men were injured, the majority of them receiving broken arms and legs. Two fire department lieutenants were killed.

Property Loss.

The entire group of buildings of ordinary construction are practically a total loss, while the chapel of fire-resistive construction is damaged by smoke and water. While some statuary and paintings were removed from various buildings which were damaged, the contents are also practically a total loss.

Conclusions.

The effects of this fire and the difficulty with which it was fought indicate the results to be expected where water supplies are inadequate. The fact that the fire did not spread to the chapel building on the west is due to the excellent work of the fire department with what poor fire streams could be secured and to the operation of the automatic tin-clad fire doors at communications to this section. An examination of the fire doors shows that apparently all operated in a satisfactory manner. Some, however, have been buried by falling walls. In several cases holes were driven into the doors by the firemen and a screen secured, behind which the fire was effectively fought.

A test of the hydrants in this vicinity, made the day after the fire, showed the following results:

Hydrant No. 1: Static pressure 140 lbs. With one hose stream on same and also one hose stream on hydrant No. 2 at the same time, pressure hydrant No. 1—5 lbs.

Hydrant No. 2: In operation by fire department—could not be tested. Delivering only a fair fire stream.

Hydrants Nos. 3, 4, and 5: Static pressure from 80-90 lbs; with one hose stream on each, pressure from 5-15 lbs.

Unusual Communicating Fire.

H-13360. Three 3-story buildings and a 4-story structure composed a group built in a hollow square around a single story boiler house and a small areaway. The two buildings at the south end of the group were a 3-story brick, joisted building at the southeast corner and a 4-story plank and timber building at the southwest, these two communicating through openings protected by double fire doors of good construction and in working order. There were no floor openings in the 3-story building, but in the other there were open stairs from the third to the fourth floor, and an elevator shaft which was enclosed and trapped at each floor with self-acting, tin-lined traps in good working condition.

Fire started from an unknown cause in the 4-story building, extending from the second to the third floor and also gaining entry to the top floor of the 3-story building. The only unusual feature about the fire in the 4-story building was the fall of the fourth floor and the collapse of the roof. This, however, was due to the fact that the fourth floor was very heavily built, being used as a tinning department in connection with the manufacture of buckles. It should be explained that the fourth story was an addition made after the completion of the original structure, the pitch of the old roof being maintained to form the pitch for the new floor, which consisted of 3-inch splined plank, several layers of tar paper, a cushion of sand, 4 inches of brick laid in cement, and a ½-inch top of cement. The bays as built for the roof being of too long span for the floor, additional timbers were placed in the centers of the bays, these new timbers being fastened to the beams by means of 8-inch angle plates and bolts which extended through the beams. The whole of this building was erected some years after the other, and in order to explain how fire communicated between them it is necessary to give details regarding the western walls of the 3-story building. This was 16 inches thick on the first floor and 12 inches thick above, and two chimneys or flues were built into it, but never carried through to the roof. To all appearances these flues were pilasters, although the roof and floor timbers did not run into them. The pilasters measured 4 x 20 inches, and the flues being 8 x 12 inches, there were four inches of brick on all sides, including that facing the 4-story building. When the latter was erected, 8 x 20-inch piers were built alongside the common wall from the ground to the roof. In one instance, at about the center of the wall, a new pier corresponded with the existing pilaster or flue. The floor timbers of the new building rested on steel plates about 10 inches square. Since the piers were only 8 inches deep, 2 inches of the old wall had to be removed in order to insert the steel plates. Of course, in removing the two inches of brick at the location just mentioned, the whole brick came out, and the timber, when inserted, extended into the old flue. No question arose at the time, as the flue was not in use and never would be.

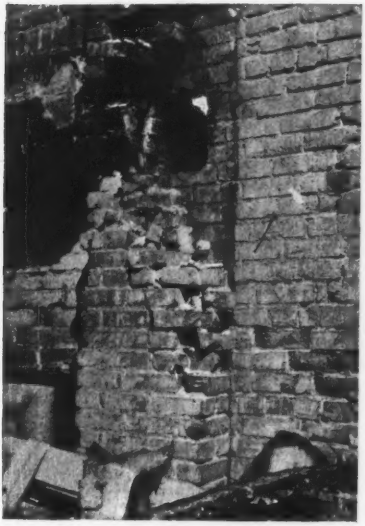


Fig. 1. Opening made by falling floor timber which had been inserted in unused flue.

Fig. 2. Removal of a single thickness of brick opened way into unused flue.

Fig. 3. Angle iron wedged between fire door and wall.

The floor timbers of the fourth floor of the new building came only a few inches below the roof of the 3-story building, and when this floor fell on the occasion of the fire the timber inserted in the flue broke the top course of brick in the pilaster on the further side, thus giving the flames access directly below the roof of the 3-story building. Fig. 1 gives a view, from the 4-story side, of the opening thus made. In Fig. 2 may be seen how in this instance the removal of a single thickness of brick opened the way into the old flue, practically canceling the protection afforded by the fire doors on the floor affected. On close examination it will be noticed that part of the bricks were broken off, not merely pushed out of the way. At the lower right-hand of this picture appears the track of the fire doors, which were still in place when the fire was extinguished.

Another very interesting condition is shown by Fig. 3. In the background can be seen a floor timber sloping to the left, and at its upper end are the angle irons which were the means of fastening it to the longitudinal beam. When the floor collapsed this timber was carried down and the angle iron wedged in between the fire door and the wall in such a manner that the door was forced open about six inches, and even the latch was broken. The door on the other side of the wall, however, held, and no fire passed through this opening.